Theory of Mind, Context Processing and Schizotypy

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Overview

This thesis will explore the relationship between theory of mind (ToM), context processing and schizotypal personality traits. Part one of the thesis is a review of the literature related to theory of mind and context processing in schizophrenia, autism and schizotypy. The review attempts to determine whether impaired ToM in schizophrenia is best understood primarily as due to difficulties associated with a defective ToM module, or rather as a consequence of more pervasive difficulties in the co-ordination of contextually relevant information (Phillips & Silverstein, 2003). Part two of this thesis presents an empirical paper examining ToM and context processing in a non-clinical population varying in schizotypy. In particular, task performance is examined in relation to group differences between high and low schizotypes and associations with analogue symptom profiles. Part 3 is a critical appraisal, which provides an opportunity for reflection on the research process.

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Part 1: Literature Review

Theory of Mind, Context Processing and Schizotypy

1. Abstract

C. Frith (1992) proposed that the clinical heterogeneity of schizophrenia could be explained by varying degrees of impairment in theory of mind (ToM). The development of this model is briefly traced with reference to the literature on autism and the empirical evidence discussed. Context processing deficits and their relationship to impaired ToM in autism are then introduced. Parallels with schizophrenia are explored with regards to the primacy and modularity of impaired ToM in schizophrenia. It is tentatively concluded that ToM is a social-cognitive form of context processing and that ToM impairments in schizophrenia reflect more general impairments in the co-ordination of contextually related information (Phillips & Silverstein, 2003). Difficulties with clinical populations are noted and the need for further research exploring relations between context processing and ToM using the schizotypy paradigm recommended.

2. Introduction

Schizophrenia is a diagnosis characterised by a wide range of symptoms. Drawing analogies with autism, C. Frith (1992) proposed that this clinical heterogeneity could be explained by a single deficit in theory of mind (ToM). This review begins by introducing the concept of ToM. C. Frith's (1992) model is briefly described and evaluated. The review subsequently continues to illustrate parallels between the autism and schizophrenia literature in an attempt to determine whether impaired ToM in schizophrenia is best understood primarily as due to difficulties associated with a defective ToM module, or rather as a consequence of more pervasive difficulties in the co-ordination of contextually relevant information (Phillips & Silverstein, 2003).

The concept of 'context' is introduced with reference to central coherence. Weak central coherence (WCC) is a context processing deficit characteristic of autism. The empirical evidence relating to WCC and its relationship to ToM in autism is reviewed first. The concept of 'context' in the schizophrenia literature is discussed and the evidence appraised. Relationships between context processing deficits and ToM in schizophrenia are subsequently evaluated and the theoretical implications considered.

There are difficulties inherent in researching clinical populations. These are discussed and the rationale for research using the schizotypy paradigm is proposed. The literature relating to schizotypy, impaired ToM and context processing deficits is then reviewed. Finally, the need for further research using the schizotypy paradigm to evaluate context processing deficits in relation to impaired ToM is recommended.

Papers for this review were identified through searches of Medline and PsychInfo, using terms including "theory of mind and schizophrenia"; "theory of mind and autism"; "theory of mind and schizotypy"; "autism and central coherence"; "schizophrenia and central coherence"; "schizophrenia and context"; "schizophrenia and perceptual organisation"; "schizophrenia and gestalt"; "schizophrenia and cognitive context"; "schizotypy and central coherence"; "schizotypy and context"; "schizotypy and perceptual organisation"; "schizotypy and cognitive context" and "schizotypy and gestalt".

3. Theory of Mind

Theory of mind (ToM) refers to the ability to infer mental states (thoughts, beliefs and intentions) of oneself and others in order to predict and understand behaviours (Premack & Woodruff, 1978). The term 'theory of mind' was first used in investigations of whether chimpanzees might possess the ability to infer the mental states of others (Premack & Woodruff, 1978). Research has since extended to investigate the development of ToM in typically developing children (e. g. Perner, Leekam & Wimmer, 1978) and the possible role of impaired ToM in a range of neuropsychiatric disorders, most comprehensively in relation to autism (e. g. Baron-Cohen, 1995), schizophrenia (e. g. C. Frith, 1992) and adult patients with frontal lobe damage (e. g. Rowe, Bullock, Pollock & Morris, 2001).

3.1 Theoretical Models of ToM

Fodor (1983) proposed that the human mind is organised according to domain-specific modules. In keeping with this, Scholl & Leslie (1999) proposed that ToM is governed by a specific ToM module (ToMM), which processes information restricted to social inference. The module is theorised to comprise an inference-making device that is dedicated to inferring mental states from behavioural data using representations of an agent's attitude. Accurate functioning of this module is determined by the functioning of a separate mechanism called a Selection Processor (SP), to separate relevant from irrelevant context information.

The 'simulation' theory suggests that the ability to infer the mental states of others is based on "putting oneself in others' shoes" (Davies & Stone, 1995). Central to this theory is an individual's ability to attribute their own mental states in a given situation to simulate what another person may be thinking or feeling in a similar scenario. At a neuronal level, this process may be reflected by the action of mirror neurones, which are active when an action is carried out by an individual and when that individual observes the same action being carried out by another (Gallese & Goldman, 1998).

Perner's (1991) 'theory-theory' model suggests that people use a commonsense theory of mind akin to a scientific theory. Attributing mental states to others arises from theoretical reasoning involving tacitly known causal laws acquired throughout development. According to a non-modular account, such reasoning is based upon a general-purpose 'scientizing algorithm' (Gopnik & Meltzoff, 1997) whereas modular theorists regard it as dependent upon the maturation of a domain specific module (Leslie, 1994).

3.2 Theory of Mind and Autism

The ToM hypothesis of autism proposes that individuals with autism are severely delayed in their acquisition of ToM as assessed by their ability to attribute false beliefs to others (e. g., Baron-Cohen, Leslie & U. Frith, 1985; Perner, U. Frith, Leslie & Leekam, 1989). Individuals with autism who are able to pass such tasks have been found to be impaired on more complex, second order tests of false belief understanding (Baron-Cohen, 1989), suggesting ToM delay in the majority of all individuals with autism. The ToM hypothesis helps explain many of the behavioural

symptoms of autism described by the triad of impairments in socialisation, communication and imagination (American Psychiatric Association, 1994; Wing & Gould, 1979). For example, social withdrawal can be seen to arise from difficulties understanding otherwise confusing behaviours in terms of mental states (Baron-Cohen, 1992, 1995; U. Frith, 1989; U. Frith, Happé & Siddons, 1994).

3.3 Theory of Mind in Schizophrenia

To date, the most influential model of ToM in schizophrenia has been the modular account of C. Frith (1992). This neuropsychological model links psychological processes to brain systems. The present review focuses on the psychological level of explanation of this model, and the reader is referred to C. Frith (1992) for discussion of the neurological level of explanation. Recently, there has also been increased interest linking impaired ToM in schizophrenia to domain general processes, particularly disorganised symptomatology.

3.3.1 C. Frith's (1992) Metarepresentational Account of Psychosis

Similarities exist between the behavioural features of autism and some of the positive and negative symptoms of schizophrenia (C. Frith & U. Frith, 1991), which relate to symptoms defined as abnormal by their presence and absence respectively (Crow, 1980). For example, people with both autism and schizophrenia can show negative symptoms such as social withdrawal, flat affect and poverty of speech in addition to positive symptoms such as inappropriate behaviours, inappropriate speech and stereotyped behaviours. Based on these similarities, C. Frith (1992) proposed a model

that suggested how varying degrees of ToM impairment could explain the clinical heterogeneity of schizophrenia.

C. Frith's (1992) model distinguished between the observable symptoms of schizophrenia, (such as poverty of speech, incoherent speech and social withdrawal) called 'behavioural signs', and the non-observable symptoms (such as persecutory delusions and delusions of reference) referred to as 'symptoms'. Using this classification, C. Frith (1992) made three specific, hierarchical predictions about the degree of impairment on tasks assessing ToM. Firstly, individuals with behavioural signs were expected to have the most severely impaired performance on the tasks, similar to the performance of individuals with autism, as they cannot represent any mental states. Secondly, individuals with paranoid symptoms but no behavioural signs were predicted to be less impaired than those with behavioural signs but more impaired than controls, because it was hypothesised that such individuals were still able to represent mental states but to make errors in the process. Thirdly, individuals with only passivity symptoms (such as thought insertion) and those in remission, were presumed to have no ToM deficit and hence to perform the same as controls.

3.3.2 Disorganised Symptoms & ToM

In contrast to C. Frith's modular account of psychotic symptoms, Hardy-Baylé (1994) suggested that impaired ToM in schizophrenia is itself a manifestation of thought and speech disorganisation resulting from defective action planning. Due to an inability representing own actions, it is hypothesised that individuals with schizophrenia will also have difficulties representing the mental states of others and integrating

contextual information (Hardy- Baylé, Sarfati & Passerieux, 2003). According to this model, ToM should be most impaired in individuals with schizophrenia who have highly disorganised thought, language and communication skills (Andreasen, 1986). In contrast, patients without disorganisation symptoms would be predicted to have preserved ToM abilities.

Disorganised symptoms represent a further symptom grouping that is reliably derived by factor analysis of the symptoms of schizophrenia (Liddle, 1987). The DSMIV (1994) and other symptom models (Spaulding, Reed, Sullivan, Richardson & Weiler, 1999) include a separate Disorganisation factor. Confusingly, Disorganisation overlaps with C. Frith's (1992) 'behavioural signs' group of symptoms. For example, disorganised speech, disorganised behaviour and inappropriate affect would be considered positive behavioural signs according to Frith's classification. However, certain negative behavioural signs are distinguishable from disorganised symptoms, such as poverty of speech, poverty of action and social withdrawal. This means that it should be possible to empirically test Hardy-Baylé's (1994) and C. Frith's (1992) models.

3.3.3 Empirical Findings

Harrington, Siegert and McClure (2005) and Brüne (2005) reviewed 30 and 23 studies respectively examining ToM in schizophrenia. Both reviews concluded that there is strong evidence for schizophrenia being associated with a deficit in ToM. According to Harrington et al. (2005), ToM performance may be influenced by executive functioning and IQ, as individuals with schizophrenia can show deficits in executive

functioning (e. g. Hutton et al., 1998); and it has been suggested that impaired ToM may be compensated for by IQ dependent problem solving skills (Pickup & Frith, 2001a). A minority of the studies reviewed controlled for this and indicated that impaired ToM can be demonstrated independently of these potentially confounding variables. However, the evidence regarding associations between impaired ToM and particular symptom profiles in schizophrenia is less clear.

3.3.3.1 Testing C. Frith's Modular Model

Studies have generally found the strongest evidence for an association between the presence of behavioural signs and impaired representation of others' mental states (e. g. Pickup & Frith, 2001). There is less clarity with regards to C. Frith's (1992) predictions regarding paranoid symptoms, with some studies showing the predicted pattern of impairment (e. g. Corcoran, Mercer & C. Frith, 1995) and others not (e. g. Grieg, Bryson & Bell, 2004). Equally, some studies have shown that patients in remission have intact ToM (e. g. Corcoran, mercer & C. Frith, 1995), but some have shown patients in remission to be as impaired as those with schizophrenia (Randall, Corcoran, Day & Bentall, 2003).

The above findings are largely reflected in a study by Pickup & Frith (2001a). ToM was assessed using a second-order false belief task based on Perner & Wimmer's (1985) 'ice-cream van' story in which participants were required to attribute a story character's false belief about another character's belief. Participants with schizophrenia were grouped hierarchically according to C. Frith's (1992) model based on their symptomatology on the day of testing as measured by a Present State

Examination (PSE; Wing et al., 1974). Participants with symptoms or signs from more than one group were allocated to the group for which poorer task performance was predicted. Participants with schizophrenia in the behavioural signs group had more impaired ToM than a non-psychotic clinical control group and a non-clinical control group, even when memory and IQ were controlled for. Pickup & C. Frith (2001) found some evidence supporting C. Frith's (1992) prediction about paranoid symptoms, although the effect was small and not robust when IQ was co-varied. In keeping with C. Frith's (1992) model, a subgroup of individuals with remitted schizophrenia and a single case with only passivity symptoms had intact ToM.

3.3.3.2 Testing Non-Modular Models

Some studies have shown the most impaired ToM performance, in terms of representing others' mental states, to be associated with high levels of thought and language disorganisation (e. g. Sarfati & Hardy-Baylé, 1999; Schenkel, Spaulding & Silverstein, 2005). Schenkel et al. (2005) assessed ToM with regards to representing others' mental states in a group of individuals with schizophrenia using the Hinting Task (Corcoran, Mercer & Frith, 1995).This task comprises stories depicting interactions between two characters in which one drops the other a hint. The aim of the task is to explain what the hint intended to communicate. Schenkel et al. (2005) assessed symptoms in their sample using the Brief Psychiatric Rating Scale (BPRS; Ventura, Green, Shaner & Liberman, 1993), providing scores for six factors: Emotional Blunting, Psychotic Disorganisation, Hallucinations/Delusions, Paranoia, Agitation/Elation and Anxiety/Depression. This symptom classification allowed the relationship between disorganised symptoms and ToM to be differentiated from C.

Frith's positive and negative behavioural signs that do not relate to disorganisation (e. g. motor hyperactivity, motor retardation, blunted affect and emotional withdrawal). Only the Psychotic Disorganisation factor significantly correlated with impaired ToM performance in Schenkel et al.'s (2005) study supporting Hardy-Baylé's non-modular account of ToM deficits in schizophrenia resulting from disorganised symptomatology.

Other studies have less clearly supported associations between disorganised symptomatology and schizophrenia. Mazza et al. (2001) found that individuals with schizophrenia and psychomotor poverty performed worse on first and second order tests of ToM than individuals with disorganised schizophrenia. Brune (2003) also reported that individuals with disorganised schizophrenia were not more impaired on picture sequencing tasks measuring first and second order ToM than controls once IQ was controlled for.

3.3.3.3 Explanations for Conflicting Results

Harrington et al. (2005) discussed how conflicting results in studies investigating ToM in schizophrenia could reflect methodological differences in sub-grouping the symptoms of schizophrenia. Another possible reason identified in their review is the variety of ToM tasks, which are likely to assess different aspects of ToM, such as first and second order false beliefs, deception, desires, intentions and jokes. Another weakness identified is that many ToM tasks have not been psychometrically evaluated. Few studies have controlled for IQ and executive functioning, meaning that results might be influenced by these potentially confounding variables. There are also

problems inherent in using clinical groups that will be discussed later as part of the rationale for research using the schizotypy paradigm.

3.4 Summary

Similarities between the features of autism and schizophrenia suggested that both disorders may be characterised by a primary deficit in ToM. C. Frith's (1992) model described how varying degrees of ToM impairment could differentially explain the clinical heterogeneity of schizophrenia. In contrast to this primarily modular account, Hardy-Baylé (1994) proposed that impaired ToM in schizophrenia is a function of disorganised symptomatology. Empirical evidence for and against both models can be found. Further research is needed to help determine which symptom profiles of schizophrenia are associated with impaired ToM and to accurately control for IQ and executive functioning.

4. Weak Central Coherence: Impaired Perceptual Organisation in Autism

Human information processing is generally characterised by a desire to achieve high-level meaning. U. Frith (1989) called this 'central coherence'. Weak central coherence (WCC) refers to the inverse cognitive style where there is a preference for detailed/local rather than global processing. Such deficits in perceptual organisation have been found to be common in autism (U. Frith, 1989) and have also been related to ToM as discussed below.

The concept of weak central coherence was first developed in the autism literature. U. Frith (1989) noted that the strengths and weaknesses of individuals with autism on a range of tasks suggested that the disorder may be characterised by perceptual organisation deficits that favour local over global contextual processing.
WCC can account for poor performance on tasks where context integration is required. For example, U. Frith & Snowling (1983) found that children with autism were more likely to pronounce the common version of a homograph irrespective of the context information contained in the sentence. Children with autism have also been shown to be less susceptible to visual illusions which are based upon integrating elements of the illusion into their inducing context (Happé, 1996; Ropar & Mitchell, 1999).

A number of studies have failed to confirm the WCC hypothesis in the autism literature (Brian & Bryson, 1996; Ozonoff, Pennington & Rogers, 1991; Hoy, Hatton & Hare, 2004). A common feature of these studies is the inclusion of participants with a wide variety of diagnoses, including Asperger syndrome and Pervasive Developmental Disorder-Not Otherwise Specified. It is possible that WCC may only be apparent in studies where participants have a diagnosis of autism (Burnette et al., 2005). Further strong support for the notion of WCC is provided by studies in which a local information processing bias provides an advantage on task performance. For example, individuals with autism have been shown to be faster than matched controls at the Embedded Figures Test (Witkin, Oltman, Raskin, & Karp, 1971), where individual shapes have to be found within a larger pattern (Jolliffe & Baron-Cohen, 1997). Similarly, Shah and Frith (1993) demonstrated that individuals with autism were faster at the standard Block Design task than matched controls. Here, patterns

have to be constructed from an example stimulus using either four or nine blocks containing components of the patterns. Such studies discount a generalised deficit explanation of test performance in autism, which might explain demonstrations of impaired performance in terms of factors such as reduced motivation and attention (Chapman & Chapman, 1978).

5. Relationships between Theory of Mind and Weak Central Coherence

Given the co-occurrence of deficits in both ToM and WCC in autism, relationships between the two have been investigated. This work has also been extended to the general population.

5.1 Autism

U. Frith (1989) argued for the primacy of WCC, stating that a ToM deficit could result from a failure to integrate relevant information from a variety of sources and that a weak drive for a "meaningful" integration of information was the "central cognitive dysfunction" associated with autism (U. Frith, 1989, p. 174). U. Frith (1989) went on to make the link between ToM and WCC even more explicit, describing ToM as "a cohesive interpretative device par excellence: it forces together complex information from totally disparate sources" (p.174).

U. Frith & Happé (1994) later changed this position. In keeping with a modular model of ToM, they suggested that the WCC and ToM hypotheses explained different aspects of autism reflecting two separate mechanisms. They cited how individuals

with autism who passed complex second-order-ToM tasks still demonstrated WCC on Block Design. Jarrold, Butler, Cottington & Jimenez's (2000) study supported U. Frith's (1989) original proposition. They compared a sample of typically developing five-year-old children with a sample of primary school aged children with autism using a range of standard ToM tasks and assessed WCC using Block Design and the Embedded Figures Test. When verbal mental age was controlled for, there was an inverse relationship between performance on the ToM tasks and the WCC tasks in both groups, indicating that people who were better at ToM also had strong central coherence. More recently, Burnette et al. (2005) reported that performance on Block Design and tests of first and second order ToM were unrelated in a sample of children with high functioning autism, but that performance on their verbal measure of WCC, the homograph task (Frith & Snowling, 1986), was related to ToM, suggesting a relationship between the two.

5.2 General Population

Baron-Cohen & Hammer (1997) found evidence of a link between WCC and ToM in a study of adults from the general population. They assessed ToM using their 'Eyes Test' in which participants have to judge how people might be feeling or what they might be thinking from a series of pictures of peoples' eyes. WCC was assessed through the Embedded Figures Test. They found that women were significantly better than men on the Eyes Test, but that men were significantly better on the Embedded Figures Test. This opposite pattern of sex differences on the two tasks suggested that individuals performing well on one task tend to perform worse on the other. Baron-Cohen & Hammer (1997) concluded that "weak central coherence may go hand in

hand with impaired mind-reading" (Baron-Cohen & Hammer, 1997, p.550). Jarrold et al. (2000) also found an inverse relationship between performance on the Embedded Figures Test and the Eyes Task in a sample of adults from the general population.

5.3 Theoretical Implications

The literature discussed above suggesting relations between ToM and WCC casts doubt upon modular conceptions of ToM, as it suggests that ToM is influenced by non-social perceptual biases. This conflicts with the concept of domain specificity required by modular systems.

5.4 Summary

There is some evidence from individuals with autism and the general population which suggest that ToM and WCC are linked. It could be that aspects of social information processing require the integration of information, such as the ability to process faces (Kaufman & Kaufman, 1983), or context-dependent language (Happé, 1997). Jarrold (2000) suggested that *strong* central coherence is important to ToM development as it biases the developing individual to take a global view of a situation and to integrate what the individual and another person are attending to. In this respect, an individual with WCC might fail to integrate separate cues into a meaningful representation of the global social situation.

6. Weak Central Coherence & Schizophrenia: Contextual Processing Deficits

A similar perceptual processing bias to that found in autism has been reported in schizophrenia (Uhlhaas & Silverstein, 2005). However, the term WCC is rarely used in the schizophrenia literature, but the concept is integrated into a more encompassing notion of 'context processing deficits'.

6.1 Definitions of Context

The word "context" is derived from the Latin "contexere" – to weave together. Different definitions of 'context' have been emphasised in the schizophrenia literature. Cohen & Servan-Schreiber (1992) identify context with task-relevant information, supplied by preceding events, that is manipulated in working memory according to task requirements. Others identify context more with the activation of information in long term memory, which leads to response biases to facilitate task-efficient behaviour (e.g. Gray, Feldon, Rawlings, Hemsley & Smith, 1991). In both of these definitions, context is seen to exert a top-down influence upon perception and cognition. Phillips & Silverstein (2003) proposed that bottom-up stimulus driven contextual information interacts with this top-down contextual information. Park, Lee, Folley and Kim (2003) elaborated on this to define the various components of context more generally in terms of perceptual context and cognitive context.

Perceptual context refers to three levels:

i) Context present in the form of the unattended features of a target stimulus. For example, if colour is the target feature, shape and texture may be part of the context.

ii) Context provided by items surrounding the target stimulus. For example, perceptual grouping may influence the processing of the target.

iii) Context provided by the temporal relationship between the target event and the contextual background. For example, lexical disambiguation is dependent upon the temporal relationship between target and context.

Cognitive context refers to two levels:

i) Long-term memory, skills and habits provide a cognitive context. This is evident in semantic priming tasks where the speed of lexical decision making is influenced by experiences and associations held in long-term memory.

ii) Task–relevant information in working memory, such as instructions, provides context. This is demonstrated in the AX-type Continuous Performance Task (described below) in which participants must respond to an X only if it follows an A.

6.2 Empirical Findings

A number of studies have investigated perceptual and cognitive context processing in schizophrenia. They have tended to refer to either perceptual *or* cognitive context. However, it is felt that Phillips & Silverstein's (2003) notion of interactions between

these two levels makes this distinction rather artificial. For example, task instructions are referred to as cognitive context in the above definition, and in this respect, all experimental paradigms involve some cognitive context. Studies reported as 'perceptual' or 'cognitive' in nature will be discussed separately below for clarity although interactions between the two should be held in mind.

6.2.1 Impaired Perceptual Context

Uhlhaas & Silverstein (2005) found that 85% of the studies included in their review of the literature indicated impaired perceptual organisation in schizophrenia. The most consistent finding was that perceptual organisation manifested as reduced responsiveness to the organisational qualities of stimuli. When symptom profiles were explored, impaired context processing was particularly associated with disorganised symptoms.

Uhlhaas et al. (2006) assessed the influence of concurrent visual context on perception using a computerised version of the Visual Size Perception Test (Phillips, Chapman & Berry, 2004), which is based on the Ebbinghaus illusion. In this task, surrounding context circles induce a size distortion on central target circles so that good performance in judging the size of the targets depends on the ability to ignore context. As predicted, Uhlhaas et al. (2006) found that participants with schizophrenia were more accurate at this task than a non-psychotic psychiatric control group. Furthermore, when participants with schizophrenia were divided into disorganised and non-disorganised groups, those with disorganised schizophrenia had the best performance, indicative of the most impaired context processing.

6.2.2 Impaired Cognitive Context

Deficits in context processing primarily relating to more top down, post-attentive processes have also been experimentally demonstrated in schizophrenia. Studies have typically adapted paradigms designed to assess executive function and selective attention, including the Wisconsin Card Sort Test (Gold, Carpenter, Randolph, Goldberg, & Weinberger, 1997); the Stroop task (Cohen, Barch, Carter & Servan-Schreiber, 1999) and the Continuous Performance Task (Elvevag, Duncan & McKenna, 2000). Such tasks have been adapted to vary the demand placed on the internal representation of cognitive context via the complexity of contextual information required to be maintained in memory, the strength of task irrelevant responses (such as automatic responses) to be ignored, and the delay between context and response. Impaired contextual processing in individuals with schizophrenia in these studies is generally demonstrated through worse performance than controls in conditions where accurate use of context is required and better performance than controls in conditions where context provides misleading information. As with perceptual context processing, such impairments have been associated with disorganised symptoms (e. g. Cohen et al., 1999).

Cohen et al. (1999) used the Continuous Performance Task (CPT) to demonstrate impaired processing of cognitive context in schizophrenia. The CPT is a visual vigilance task in which a series of sequentially presented single numbers or letters are monitored. Cohen et al.'s (1999) task required participants to respond to a target 'X' only when it was preceded by an 'A' and not a 'B'. A strong tendency to respond to an X was established by the majority of trials being the target sequence (AX). An

inappropriate expectancy bias was also introduced in which an 'A' was followed by a 'Y'. Healthy and depressed control participants made more errors in this expectancy bias condition compared to the simple AX/BX conditions. In contrast, participants with schizophrenia showed the opposite pattern of results. They made more errors in the AX and BX conditions, but not in the AY condition. In the former, impaired processing of cognitive context in terms of the accurate maintenance of task instructions resulted in more errors, where as in the latter, it resulted in less. Cohen et al. (1999) found that impaired contextual processing was associated with higher levels of disorganised symptomatology and could be dissociated from short term memory impairments.

6.3 Phenomenological Experience of Context Processing Deficits

The experimental evidence cited above indicating disrupted context processing has been related to the phenomenological experience of schizophrenia. Matussek (1952/1987) believed the perceptual world of individuals with schizophrenia was characterised by a splitting of individual perceptual components from their natural context. Hemsley (2005) also noted how impaired processing of cognitive context might explain the experience of schizophrenic symptoms such as delusional thinking. For example, the failure of context to activate appropriate stored material could result in delusional beliefs being inferred on the basis of a single co-occurrence due to past regularities not being processed.

6.4 Summary

There is good evidence to indicate impaired processing of perceptual and cognitive context in schizophrenia. Experimental manipulations in which impaired context processing results in enhanced task performance indicate that such deficits cannot be explained by a general deficit model in which task performance is accounted for by other illness-related disabling factors such as apathy or inattention. As with impaired ToM task performance in schizophrenia, such deficits have been found to be associated with disorganised symptoms, suggesting both impairments may be related.

7. Relationships between context processing deficits and theory of mind in schizophrenia

Context processing deficits have been shown to be particularly marked in individuals with poor premorbid social functioning. For example, Silverstein et al. (1996) investigated perceptual context processing in individuals with schizophrenia using an adaptation of Banks & Prinzmetal's (1976) visual search task. Participants had to report whether a 'T' or an 'F' was present in an array consisting of T-F hybrids that were perceptually grouped with noise elements to vary task difficulty. In the difficult condition, a serial search process was required. In the easier conditions, the noise elements were grouped together separately from the target. Impaired context processing in individuals with schizophrenia classified as having poor premorbid social functioning (identified by an adaptation of Phillips' (1953) scale of premorbid social adjustment) was shown by their faster performance on the difficult condition compared to individuals with schizophrenia and good premorbid social functioning.

Intact ToM has been linked to better overall social functioning in schizophrenia (Roncone, Falloon & Mazza, 2002), suggesting that context processing deficits may impact upon ToM. Green, Uhlhaas & Coltheart (2005) suggested how deficits in context processing could lead to reduced social competence at an early age in people generally. In particular, they noted how context processing is necessary for the deciphering of biological motion perception, which may play an important role in the development, acquisition and maintenance of ToM (Blakemore & Decety, 2001).

7.1 Empirical Evidence

To date, three published studies have directly investigated relations between ToM and context processing in schizophrenia. Uhlhaas et al (2006) compared the performance of individuals with schizophrenia to controls on three measures of ToM: a first-order ToM task (Wimmer & Perner, 1983), the 'Hinting Task' (Corcoran, Mercer & Frith, 1995) and the 'Eyes Test' (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001). Context processing was assessed using the Visual Size Perception Test described above. Symptomatology of participants with schizophrenia was assessed using the Positive and Negative Syndrome Scale (PANSS: Kay, Opler & Fiszbein, 1987) and then subsequently grouped into six factors: Disorganised, Positive, Negative, Excitement, Cognitive and Depression. Uhlhaas et al. (2006) found significant negative correlations between performance on the visual size perception task, the Hinting Task and a composite ToM score. This suggests that reduced sensitivity to surrounding visual context was associated with impaired performance on ToM tasks. The Cognitive Disorganisation factor was the only symptom group consistently

correlated with impairments in perceptual context processing as well as the composite ToM score.

Schenkel, Spaulding & Silverstein (2005) investigated ToM in individuals with schizophrenia using the Hinting Task (Corcoran et al., 1995), which assesses the ability to infer the intentions behind indirect speech utterances. Performance on this task was compared with two measures of context processing: the Contour Integration Test (Kovács, Kozma, Fehér & Benedek, 1999) and a modified version of the Hayling Sentence Completion Test (Burgess & Shallice, 1997). In the latter task, the scoring system was modified so that each response was classified according to a four point scale ranging from 1 (not appropriate) to 4 (appropriate). The Contour Integration Test requires a circular contour of elements to be identified from a background of elements. Impaired ToM performance was associated with impaired context processing in both tasks. Control measures indicated that executive and general intellectual functioning could not explain this association. Impaired ToM and context processing deficits were both significantly associated with the Psychotic Disorganisation factor of the Brief Psychiatric Rating Scale (BPRS; Ventura, Green, Shaner & Liberman, 1993), but not with any of the other five factors.

Penn, Ritchie, Francis, Combs & Martin (2002) investigated context processing in schizophrenia across a range of tasks assessing social cognition. Two of these tasks required ToM. The Gilbert-Pelham Task (GPT; Gilbert, Pelham & Krull, 1988) requires participants to watch a silent video of a woman who appears anxious. The images are accompanied by subtitles that provide context information regarding topics that are either congruent with anxiety (e. g. public humiliation) or not (e. g.

fashion trends). Participants are then required to rate the woman's trait and state anxiety in various social situations. High and low ratings of trait and state anxiety following the incongruent and congruent context conditions respectively are hypothesised to reflect effective use of context, as high levels of anxiety in the congruent, but not incongruent, conditions would be expected. The Situation Matching Task (SMT: Ferman, 1993) requires participants to match the emotion displayed by a target cartoon character across different contexts. As expected, Penn et al. (2002) found that individuals with schizophrenia did not utilise context in these tasks. However, the same was true for healthy control participants. Different reasons for this finding in the two groups were suggested. Control participants appeared to choose not to use context information, but individuals with schizophrenia appeared preoccupied with the context rather than not processing it. Another possibility is that the measures used were of questionable validity in assessing context processing in social cognition. Penn et al. (2002) did find some evidence from their measures indicating an association between impaired social context processing and reduced social competence on the ward as assessed by the Nurse's Observation Scale for Inpatient Evaluation (NOSIE-30; Hongfield, Gillis & Klett, 1996).

7.2 Summary

Reflecting research in autism, there is evidence to suggest that impaired ToM in schizophrenia may be related to impaired context processing. There is some evidence that both impairments are associated with disorganised symptoms, which suggests that ToM may be a social cognitive form of context processing (Silverstein & Phillips, 2003) and that disorganised symptoms are the clinical manifestation of a

more generalised disorganisation in the co-ordination of contextually related information (Uhlhaas et al., 2006). Such a notion is contrary to modular models of ToM and calls into question the primacy of a deficit in ToM in explaining the symptoms of schizophrenia.

8. Difficulties Researching Clinical Populations

When interpreting results from clinical samples, findings may be influenced by a host of potentially confounding factors including medication, heterogeneity of the samples, poor motivation, small sample sizes etc (Abdi & Sharma, 2004). Such variables could explain the inconsistent results regarding which symptoms of schizophrenia are associated with impaired ToM. Additionally, the conceptual validity of impaired ToM in schizophrenia is questioned when one considers that it might be an artefact of the institutionalisation, social withdrawal and alienation typical of severe and enduring mental health problems (Langdon & Coltheart, 1999). These crucial issues suggest that other paradigms are needed to advance research in this area.

8.1 Schizotypy

To address the issues raised above, clinical research can be complemented by testing healthy individuals in the general population who show sub-clinical features of schizophrenia expressed as part of the normal diversity of personality. Many studies indicate that psychosis-like symptoms and experiences are apparent in the general population, suggesting a continuity model of psychosis (for review, see Myin-Germeys, Krabbendam & van Os, 2003). 'Schizotypy' is a term that relates to such a

continuity model. It acknowledges the presence of psychotic-like features in the general, non-clinical population, such as belief in telepathy and magic (Claridge & Beech, 1995). According to the continuity model, the clinical symptoms of psychosis are considered as extreme manifestations of these variations in the general population, with those in the general population high in schizotypy resembling individuals with psychosis most closely. In this respect, the study of non-clinical individuals high in schizotypy can facilitate our understanding of schizophrenia.

8.2 Schizotypy and Theory of Mind

Three published studies have examined the relationship between schizotypy and ToM. Langdon & Coltheart (1999) examined the performance of healthy, non-clinical participants on a picture-story sequencing task. Participants' degree of schizotypy was assessed using the Schizotypal Personality Questionnaire (SPQ; Raine, 1991) which measures 3 schizotypy factors: Cognitive-Perceptual, Interpersonal and Disorganised. The stories consisted of a series of cartoon pictures that had to be ordered so as to tell a meaningful story. They depicted either 'mechanical', 'social - script' or 'false belief' scenarios. 'Mechanical' stories depicted sequences of physical cause and effect events and tested the ability to infer causal relations. 'Social-script' stories depicted people carrying out everyday social routines and tested ability to reason logically using social-script knowledge. ToM was assessed through 'False Belief' stories, which featured a character who acted on the basis of information that participants knew to be false.

In keeping with their hypothesis, Langdon & Coltheart (1999) found that high schizotypes performed significantly poorer on the ToM task relative to low schizotypes. There were no significant group differences on the other story tasks. Langdon & Coltheart (1999) had expected impaired ToM to be associated with the psychotic-like Cognitive-Perceptual factor (magical thinking, unusual perceptual experiences). However, only the Interpersonal factor (including suspiciousness and paranoia, social anxiety, few friends and constricted affect) was associated with impaired ToM. There were no differences in scores on the Disorganised or Cognitive-Perceptual factors.

Langdon & Coltheart (1999) conducted an extended replication of the above study to control for executive functioning and ceiling effects with the ToM task by including a computerised version of the Tower of London task, taken from the Cambridge Neuropsychological Test Automated Battery (CANTAB), and set of 'capture' stories, which were harder than the 'false belief' stories. In keeping with the first part of their study, high schizotypes were characterised by poor theory of mind relative to low schizotypes, but there were no differences on the other story types, including the 'capture' stories. This difference could not be explained by executive planning deficits as there were no differences in performance between high and low schizotypes on the Tower of London task. However, contrary to the first part of their study, impaired ToM was associated with the Cognitive-Perceptual and Disorganised factors of the SPQ. Langdon & Coltheart (1999) relate this finding to possible differences in the two samples used.

In a later study, Langdon & Coltheart (2004) found that high schizotypes were more impaired at understanding irony than low schizotypes, and that this effect was particularly associated with the Cognitive-Perceptual factor of the SPQ. There were no differences in performance on a metaphor task, a finding which corresponds with the view that understanding irony is a task that requires a higher level of ToM than does metaphor (Happé, 1993).

Pickup (2006) assessed ToM in schizotypy using Fletcher et al's (1995) story task. Schizotypy was assessed using the Oxford-Liverpool Inventory of Feelings and Experiences (O-LIFE; Mason, Claridge & Jackson, 1995). This questionnaire measures four factors: 'Unusual Experiences'; 'Cognitive Disorganisation'; 'Impulsive Nonconformity' and 'Introvertive Anhedonia'. The story task comprised 16 short passages of text, which were each followed by a question. There were 8 ToM stories and 8 control 'physical' stories, which did not require mental state attribution. As additional control measures, IQ and executive function were also assessed.

Contrary to what was expected, Pickup (2006b) found no significant association between ToM performance and total schizotypy scores. Equally, there were no significant differences in ToM performance according to schizotypal traits analogous to C. Frith's (1992) behavioural signs or those allocated to a 'no symptom' group. However, a regression analysis indicated that high scores on the Unusual Experiences factor of the O-LIFE predicted poorer ToM when verbal IQ and executive function were controlled for. No association was found with scores on the 'physical' stories, indicating that this relationship was specific to ToM. This finding was reported as

providing some evidence that experiences analogous to the paranoid symptoms of schizotypy are associated with poorer ToM.

Pickup (2006) suggested that differences in the item weightings in the SPQ and O-LIFE could explain why there was no difference between high and low schizotypes on ToM scores using the O-LIFE, but there was such a difference using the SPQ in the study by Langdon & Coltheart (1999). The SPQ is weighted in favour of items that correspond to the Unusual Experiences factor of the O-LIFE. In this respect, it is possible that Langdon & Coltheart's (1999) finding reflects the association found in the regression analysis by Pickup (2006). Another reason suggested for the lack of association between total schizotypy scores and ToM relates to the task administration. Pickup (2006) proposed that making the task more 'on-line' by having the stories read aloud to participants might make the task more sensitive to between-subject differences.

8.3 Summary

There is some evidence that ToM is impaired in healthy, non-clinical individuals who are high in schizotypy. This confirms that ToM impairments in schizophrenia cannot be considered an artefact of the chronic associality that is typical of severe and enduring mental health problems. There is less clarity regarding the symptom profiles associated with impaired ToM in schizotypy, with evidence for schizotypal traits analogous to disorganised, paranoid and negative symptoms being associated with ToM impairments. These differences may be partly explained by differences in the measures used to group symptom profiles.

8.4 Schizotypy and Context Processing Deficits

Several studies have investigated perceptual context processing in schizotypy but few have explicitly examined cognitive context.

8.4.1 Perceptual Context

Rawlings & Claridge (1984) investigated the performance of individuals high and low in schizotypy on the Navon (1977) letter identification task, in which the dependent variable is reaction time to identify pointilistic renditions of letters made up of smaller letters. Participants were requested to respond to either the global or local form. Intact context processing is indicated by a preference for global information, referred to as a 'global precedence' effect by Navon (1977). This global precedence effect is also evident in involuntary interference from the global-to-local level but not from the local-to-global level. Rawlings & Claridge (1984) found that individuals high in schizotypy showed an advantage over those low in schizotypy in processing local information, suggesting impaired contextual processing. After controlling for IQ, but not executive functioning, this local information processing advantage has been associated with high scores on the Unusual Experiences and Cognitive Disorganisation factors of the O-LIFE (Goodarzi, Wykes & Hemsley, 2000).

Tsakanikos & Reed (2003) measured contextual processing using the Hidden Figures Test (Ekstrom, French, Harman & Dermen, 1976) in which participants have to identify which one of five simple figures is hidden in a complex visual configuration. In this respect, it is similar to the adult version of the Embedded Figures Test (Witkin

et al., 1971). Tsakanikos & Reed (2003) predicted that participants high in schizotypy would perform *worse* on this task compared to those low in schizotypy. This is in conflict with the literature base on context processing deficits discussed above, linking schizophrenia to *enhanced* performance on tasks that favour a local processing style. Tsakanikos & Reed (2003) suggested that schizophrenia is associated with poor top-down processing, and proposed that top-down processing is required for figure-ground segregation. The results of their study were mixed. Enhanced performance, indicative of context processing deficits, was associated with high scores on the 'Impulsive Non-Conformity' scale of the O-LIFE, but high scores on the 'Introvertive Anhedonia' scale were associated with poorer performance.

Contrary to their predictions, Pickup & Frith (2001b) found no differences between high and low schizotypes on a modified version of the Embedded Figures Task (Pickup, 1997), and no significant associations between task performance and factor scores of the O-LIFE. It is possible that context processing deficits in schizotypy are not very pronounced (Silverstein, Raulin, Pristach & Pomerantz, 1992) and that Pickup's (1997) modified version of the Embedded Figures Task was not sensitive enough to detect any subtle differences.

Uhlhaas, Silverstein, Phillips & Lovell (2004) assessed visual context processing in individuals assessed for schizotypy and thought disorder as measured by the SPQ (Raine et al., 1991) and the short form of the Thought Disorder Index (TDI) (Carpenter, Coleman, Waternaux & Perry, 1993) respectively. Visual context processing was assessed through the Contour Integration Task and the Visual Size Perception Task described earlier. It was hypothesised that compared to low

schizotypes, context processing deficits in high schizotypes would be evident in impaired performance on the Contour Integration Task and enhanced performance on the visual size perception task. Furthermore, it was hypothesised that such context processing deficits would be associated with the disorganised symptoms of schizotypy and hence particularly evident in positively thought disordered participants. They found no significant differences in total scores between high and low schizotypes on either of the context processing tasks and no significant associations between the individual factors of the SPQ and performance on these tasks. However, the expected pattern of results was found when the analyses were repeated comparing high schizotypes who were also high in thought disorder with high schizotypes low in thought disorder and low schizotypes (who were not assessed, but assumed to be low in thought disorder). This suggests that high schizotypy combined with high thought disorder may be a more sensitive measure of disorganisation than schizotypy alone in the non-clinical population.

8.4.2 Cognitive Context

Few studies have directly investigated cognitive context processing in relation to schizotypy. Using the Perceptual Aberration Scale, (Chapman, Chapman, & Raulin, 1978), Park, Holzman & Lenzenweger (1995) compared the performance of high and low schizotypes on an oculmotor memory task in which participants had to indicate the location of a visually presented target with their eyes. Cognitive context was manipulated by varying the delay between presentation of the target and participants' responses, and the inclusion of a distracter stimulus. Compared to a control task, in which the target was present throughout the task, individuals high in schizotypy had

poorer performance indicative of impaired cognitive context in the more demanding cognitive context conditions than low schizotypes

8.5 Summary

As with the literature discussed above in relation to autism and schizophrenia, there is some evidence to suggest that healthy, non-clinical individuals high in schizotypy, specifically those also high in thought disorder, have perceptual contextual processing deficits. The effect may be less pronounced in non-clinical samples, emphasising the need for sensitive tests of context processing. Although some studies have controlled for IQ, few have controlled for executive functioning. Future studies should carefully control for both, as executive functioning has been shown to vary with schizotypy (Raine, Sheard, Reynolds & Lencz, 1992).

9. Conclusions and Future Directions

There are strong parallels between ToM research in the fields of autism and schizophrenia. There is good evidence that ToM is impaired in schizophrenia and in individuals who are high in schizotypy. There is however less clarity regarding which symptom profiles are associated with impaired ToM.

In addition to impaired ToM, autism, schizophrenia and high schizotypy have also been associated with perceptual and cognitive context processing deficits. There is some evidence of a relationship between impaired ToM and contextual processing deficits in the general population, in schizophrenia and in individuals who are high

schizotypy, which challenges notions of both the primacy and modularity of a ToM deficit. To account for this relationship, it has been suggested that ToM is a social-cognitive form of context processing and that impaired ToM is one consequence of a larger impairment in the co-ordination of contextually relevant material (Phillips & Silverstein, 2003) clinically manifested in the disorganised features of schizophrenia (Uhlhaas et al., 2006).

Only three studies have directly investigated relationships between impaired ToM and contextual processing deficits in schizophrenia. To date, no studies have investigated relationships between ToM and context processing deficits using the schizotypy paradigm. Given the difficulties discussed above concerning research with clinical samples, such research would help clarify the nature of any relationship and is a priority in this field.

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Part 2: Clinical Paper

Theory of Mind, Context Processing and Schizotypy

1. Abstract

Investigations have demonstrated impaired theory of mind (ToM) in schizophrenia, but little is known about the mechanisms associated with such impairment. Using the schizotypy paradigm, the present study examined the proposal that impaired ToM is associated with impaired context processing. 80 participants varying in schizotypy completed a schizotypy questionnaire (the Oxford-Liverpool Inventory of Feelings and Experiences; O-LIFE), the Thought Disorder Index (TDI), two ToM tasks (a picture-story sequencing task and the Eyes Test) and two perceptual context processing tasks (Block Design and the Hidden Figures Test). Executive functioning was assessed using the Brixton test, non-verbal IQ was assessed using the Test of Non-Verbal Intelligence – 3rd edition (TONI-3) and verbal IQ was assessed using the Wechsler Abbreviated Scale of Intelligence (WASI). The non-significant findings of this study are discussed in relation to previous studies and the need for further extended replications.

Introduction

2.1 Theory of Mind & Schizophrenia

Theory of mind (ToM) refers to the ability to infer mental states of oneself and others in order to predict and understand behaviour (Premack & Woodruff, 1978). Impaired ToM has been proposed as an explanation for the behavioural features of autism (e. g. Baron-Cohen, 1992; U. Frith, 1989). Based on similarities observed between such features and some of the symptoms of schizophrenia, C. Frith (1992) proposed a model that explained the clinical heterogeneity of schizophrenia in terms of varying degrees of impairment in ToM. Numerous studies have explored ToM in schizophrenia (for reviews, see Brüne, 2005; Harrington, Siegert & McClure, 2005). The overall finding from these studies confirms that ToM is impaired in schizophrenia, but uncertainty remains regarding which symptom profiles of schizophrenia are associated with impaired ToM and, more specifically, whether such impairment is best explained by modular (Fodor, 1983; Scholl & Leslie, 1999) or non-modular accounts of the human mind (e. g. Perner, 1991; Davies & Stone, 1995).

2.2 C. Frith's (1992) Metarepresentational Account of Psychosis

C. Frith's (1992) proposed three specific, hierarchical predictions based on a classification of symptoms into those which can be observed and those which cannot, referred to as 'behavioural signs' and 'symptoms' respectively. Firstly, behavioural signs (e. g. motor retardation, incoherence and poverty of speech) were hypothesised to reflect the most severe impairments of ToM, similar to those found in autism.

Secondly, individuals with paranoid symptoms (e. g. persecutory delusions and delusions of reference) were predicted to be less impaired than those with behavioural signs, but more impaired than controls. This is because such individuals were theorised to represent mental states of others, but erroneously. Finally, those with passivity symptoms (e. g. thought insertion and delusions of control) and those in remission were expected to have intact attribution of others' mental states. C. Frith's (1992) model has received most support for the first of these predictions (e. g. Pickup & Frith, 2001; Langdon et al., 1997), whereas findings relating to the second and third predictions are more mixed (e. g. Corcoran, Mercer & Frith, 1995; Greig, Bryson & Bell, 2004; Frith & Corcoran, 1996).

2.3 Theory of Mind and Context Processing

In contrast to C. Frith's (1992) modular account, others have proposed that impaired ToM is itself the consequence of more pervasive difficulties in the co-ordination of contextually related information in schizophrenia (Phillips & Silverstein, 2003), which is clinically manifested in the disorganised symptoms of schizophrenia (Uhlhaas et al., 2006). Such theories suggest that ToM is a social-cognitive form of context processing. There is some support for an association between impaired ToM in schizophrenia and disorganised symptoms (e. g. Sarfati & Hardy-Baylé, 1999; Schenkel, Spaulding & Silverstein, 2005) and good evidence to suggest that schizophrenia is characterised by context processing deficits of both a perceptual and cognitive nature (e. g. Uhlhaas & Silverstein, 2005; Cohen, Barch, Carter & Servan-Schreiber, 1999). Contextual processing deficits in schizophrenia have been shown to impair performance relative to controls on tasks where context integration is required

(e. g. Silverstein et al., 2000); and to enhance performance on tasks where context information is misleading (e. g. Silverstein, Kovács, Corry, & Valone, 1996). Such examples of enhanced performance discount explanations that impaired task performance in schizophrenia is simply due to generalised effects of psychiatric illness (Chapman & Chapman, 1978).

A parallel line of inquiry is evident in the autism literature. There is some evidence that autism is associated with a context processing deficit, referred to as weak central coherence (WCC), characterised by a local information processing bias that leads to surrounding context information being ignored (e. g. U. Frith, 1989; Frith & Snowling, 1983). U. Frith (1989) argued for the primacy of WCC in autism, stating that a ToM deficit could result from a failure to integrate relevant information from a variety of sources and that a weak drive for "meaningful" integration of information was the "central cognitive dysfunction" associated with autism (p.174). Jarrold, Butler, Cottington & Jimenez (2000) demonstrated support for this in an inverse relationship found between performance on tasks of ToM and WCC in samples of primary-school-aged children with typical development and autism. A similar inverse relationship between ToM and WCC has also been reported in adults in the general population (Baron-Cohen & Hammer, 1997; Jarrold, Butler, Cottington, & Jimenez, 2000).

Context processing deficits have been shown to be particularly marked in individuals with schizophrenia with poor premorbid social functioning (Silverstein et al., 1996), and ToM has been linked to overall social functioning in schizophrenia (Roncone, Falloon & Mazza, 2002). This suggests that context processing deficits may be

impacting on ToM in the disorder. To date, few studies have investigated relations between ToM and context processing in schizophrenia. Schenkel, Spaulding & Silverstein (2005) compared ToM performance on the Hinting Task (Corcoran et al., 1995) with performance on two perceptual context processing tasks. Impaired ToM was associated with impaired context processing on both tasks and these impairments were only significantly related to the Psychotic Disorganisation factor of the Brief Psychiatric Rating Scale (BPRS; Ventura et al., 1993). Uhlhaas et al (2006) also explored relationships between performance on three ToM tasks and a perceptual context processing task in schizophrenia. They found significant correlations between perceptual context processing and ToM, suggesting that impaired context processing was associated with impaired performance on the ToM tasks. From their classification of symptoms derived from the Positive and Negative Syndrome Scale (PANSS: Kay, Opler & Fiszbein, 1987), Cognitive Disorganisation was also the only symptom group consistently correlated with impairments in perceptual context processing as well as ToM.

2.4 Schizotypy

Methodologically, research using participants with schizophrenia is subject to potentially confounding variables such as medication, poor motivation and small sample sizes (Abdi & Sharma, 2005). Langdon & Coltheart (1999) also raised an important conceptual confound suggesting that ToM impairments observed in schizophrenia could be an artefact of the chronic associality typical of severe and enduring mental health problems. To address these issues, clinical research can be complemented by testing healthy individuals in the general population. Many studies

indicate that psychosis-like symptoms and experiences are apparent in the general population, suggesting a continuity model of psychosis (for review, see Myin-Germeys, Krabbendam & van Os, 2003). 'Schizotypy' is a term that relates to such a continuity model. It acknowledges the presence of psychotic-like features in the general, non-clinical population, such as belief in telepathy and magic (Claridge & Beech, 1995). According to the continuity model, those in the general population high in schizotypy resemble individuals with psychosis most closely (Claridge, 1994). Although there are similarities that make comparison between clinical and non-clinical groups helpful, there are also important limitations that need to be considered. For example, there could be differences in the intensity of experiences, how they are interpreted and the impact they have upon an individual's life. Personality is also just one feature in the complex combination of genetic and environmental factors that can contribute to a clinical presentation.

2.5 Schizotypy and ToM

Three published studies have investigated ToM in schizotypy. They provide some evidence that ToM is impaired in individuals high in schizotypy but less clarity regarding which analogue symptom profiles of schizotypy are associated with the impairment. This may relate to different ways in which symptoms were grouped across studies. Langdon & Coltheart's (1999) two-part study classified participants into high and low schizotypes using the Schizotypal Personality Questionnaire (SPQ; Raine, 1991) and compared group performance on their picture-story sequencing task. Compared to the control stories, high schizotypes demonstrated more impaired sequencing of the ToM stories and longer reaction times to correctly sequence ToM

stories than low schizotypes. In the first part of their study, impaired ToM was associated with the Interpersonal factor of the SPQ. In an extended replication of this study to control for executive functioning and ceiling effects, impaired ToM was associated with the Cognitive-Perceptual and Disorganised factors of the SPQ. In a later study, Langdon & Coltheart (2004) found that impaired ToM (indicated by reduced understanding of irony) was also associated with the Cognitive-Perceptual factor of the SPQ. Pickup (2006) assessed ToM in schizotypy using Fletcher et al's (1995) story task. Schizotypy was assessed using the Oxford-Liverpool Inventory of Feelings and Experiences (O-LIFE; Mason, Claridge & Jackson, 1995). Pickup (2006) found no differences in ToM when high and low schizotypes were compared. However, a regression analysis indicated that high scores on the Unusual Experiences factor of the O-LIFE predicted poorer ToM when IQ and executive function were controlled for, providing some evidence that experiences analogous to the positive symptoms of schizophrenia are associated with poor ToM.

2.6 Schizotypy and Context Processing

Several studies have explored perceptual context in schizotypy. There is good evidence to suggest that healthy, non-clinical individuals high in schizotypy demonstrate more perceptual contextual processing deficits than low schizotypes. Using the Navon (1977) letter identification task, high schizotypy has been associated with a local information processing advantage, contrary to the global precedence effect typically found (Rawlings & Clardige, 1984). The findings regarding which analogue symptom profiles are associated with impaired context processing have been more varied. For example, the local information processing bias on the Navon (1977)

task has been associated with the Unusual Experiences and Cognitive Disorganisation factors of the O-LIFE (Goodarzi, Wykes & Hemsley, 2000) whereas Tsakanikos & Reed (2003) reported that enhanced performance on the Hidden Figures Test (Ekstrom, French, Harman & Dermen, 1976), indicative of context processing deficits, was associated with the Impulsive Non-Conformity factor of the O-LIFE, and that impaired performance was associated with the Introvertive Anhedonia factor. Uhlhaas, Silverstein, Phillips & Lovell (2004) found no differences in context processing performance on the Contour Integration task (Kovács, Kozma, Fehér & Benedek, 1999) or the Visual Size Perception Task (Phillips, Chapman, & Berry, 2004) when high and low schizotypes were compared. However, high schizotypes who were also high in thought disorder, as measured by the Thought Disorder Index (Carpenter, Coleman, Waternaux & Perry, 1993), demonstrated more impaired context processing than high schizotypes who were low in thought disorder, and low schizotypes (who were not assessed for thought disorder). Baron & Kenny (1986) noted that inconsistent relations between a predictor and an outcome across studies suggests the involvement of a moderator variable. It is possible that thought disorder acts as a moderator in the relation between high schizotypy and performance on tasks of context processing and ToM.

2.7 Aim of Present Study

To date, no published studies have explored relationships between ToM and context processing using the schizotypy paradigm. The current study aims to do this using a sample of participants ranging in schizotypy recruited from the general population. Symptom profiles analogous to those found in schizophrenia will be measured using

the O-LIFE. As an additional indicator of disorganisation, thought disorder will be assessed using the Thought Disorder Index (Carpenter et al., 1993). ToM will be assessed using Langdon & Coltheart's (1999) Picture-Story sequencing task and the 'Eyes Test' (Baron-Cohen, Wheelwright, Hill, Raste & Plumb, 2001). Context processing will be investigated using the Hidden Figures Test (Ekstrom, French, Harman & Dermen, 1976) and the Block Design subset of the Wechsler Abbreviated Scale of Intelligence (WASI; Psychological Corporation, 1999). Non-verbal IQ will be controlled for using the Toni-3 (Brown, Sherbenou & Johnsen, 1998) and Verbal IQ using the Vocabulary and Similarities subscales of the WASI. Executive functioning will be controlled for using the Brixton Spatial Anticipation Test (Burgess & Shallice, 1997). High schizotypy, particularly the analogue symptoms associated with the Disorganised factor of the OLIFE, and high thought disorder are predicted to be associated with impaired ToM task performance but enhanced performance on the context processing tasks, reflecting pervasive difficulties in the co-ordination of contextually relevant information (Phillips & Silverstein, 2005).

The specific hypotheses are:

1) High schizotypes will have lower position scores on the False Belief stories task than low schizotypes, but similar performance on the other story types (replicating Langdon & Coltheart (1999)).
2) High schizotypes will take longer to correctly sequence False Belief stories than low schizotypes (replicating Langdon & Coltheart (1999)).
3) High schizotypes will perform worse on the Eyes Test than low schizotypes.

4) Cognitive Disorganisation will predict impaired performance on the False Belief stories and the Eyes Test independently of IQ and executive functioning.
5) High schizotypes will perform significantly better on the Block Design and Hidden Figures Test compared to low schizotypes.
6) Cognitive Disorganisation will predict enhanced performance on the Block Design and Hidden Figures Test independently of IQ and executive functioning (extended replication of Tsakanikos & Reed (2003).
7) Performance on the ToM and context processing tasks will be inversely related.
8) High schizotypes with high thought disorder will have significantly more impaired performance on the ToM tasks than low schizotypes with low thought disorder.
9) High schizotypes with high thought disorder will have significantly better performance on the context processing tasks than low schizotypes with low thought disorder (extended replication of Uhlhaas, Silverstein, Phillips & Lovell, 2004).

3. Methodology

3.1 Participants

An a-priori power analysis using Zumstat Software (version 2.5) indicated that 80 participants were required. A medium effect size of 0.15 was used in the calculation based on the significant effect of 0.122 reported in Pickup (2006) and Cohen's (1992)

formula. The significance level was set to a standard 0.05 level and the power at the standard 0.8.

Eighty participants were recruited through associates of the researcher, adverts, and a predominantly, although not exclusively, student population from the University College London (UCL) subject pool. Inclusion criteria were English as a first language, an age between 18 and 70, and no history of psychiatric illness or head injury. An on-line version of the Schizotypal Personality Scale (STA) of the Claridge and Broks (1984) Schizotypy Questionnaire (STQ) (see Appendix 1) was used as a screening measure to ensure that a sample representing a broad range of schizotypy was recruited. Participants were categorised as either, 'high' 'medium' or 'low' schizotypes based on their STA scores in relation to the population mean. High schizotypes scored more than one standard deviation above the mean on the STA, medium schizotypes were within one standard deviation of the mean, and low schizotypes scored greater than one standard deviation below the mean. In total, 34 males and 46 females participated in the study. Their ages ranged between 18 and 67 years (mean (SD) = 27.49 (10.73)). Ten participants fell within the 'low' range on the STA (6 males, 4 females; mean (SD) age = 30.4 (12.8)). Thirty-five participants fell within the 'average' range on the STA (13 males, 22 females; mean (SD) age = 26.4 (9.66)). Thirty-five participants fell within the 'high' range (15 males, 20 females; mean (SD) age = 27.74 (11.27)).

The Lie Scale of the Short Form of the Eysenck Personality Questionnaire-Revised (EPQ-R; Eysenck & Eysenck, 1991) was incorporated into the STA. The measure consists of 12 questions which assess the tendency to give false, socially desirable

responses. At the screening stage, 4 participants scored more than 2 SDs above the population mean on the Lie Scale and were not recruited to take part in the rest of the study. The other responses on the Lie Scale were low, ranging between 0-2.

3.2 Materials

Following the screening procedure outlined above, all participants completed the following measures:

3.2.1 Dimensional Assessment of Schizotypy: The Oxford-Liverpool Inventory of Feelings and Experiences (O-LIFE; Mason, Claridge & Jackson, 1995)

The O-LIFE (see Appendix 2) is a self-report measure consisting of 104 questions that measure four scales: Unusual Experiences, Cognitive Disorganisation, Introvertive Anhedonia and Impulsive Non-Conformity. The four scales are analogous to the symptom dimensions of schizophrenia (e.g. Mason & Claridge, 2006). The Unusual Experiences (UE) subscale contains perceptual, hallucinatory and magical thinking items and can be considered a non-clinical analogue of the positive symptoms of psychosis. The Cognitive Disorganisation (CD) sub-scale relates to difficulties with attention, concentration, decision-making and social anxiety. The Introvertive Anhedonia (IA) sub-scale describes difficulties with enjoyment, avoidance and intimacy and can be considered a non-clinical analogue of the negative symptoms of psychosis. Impulsive Non-Conformity (IN) contains items that describe impulsive, anti-social and eccentric forms of behaviour. Scores on the O-LIFE have been shown to vary according to sex and age (Mason & Claridge, 2006). To account

for this, raw scores were standardised using the Mason & Claridge (2006) population norms. Test-retest reliability is reported to be high across all four sub-scales of the O-LIFE, being greater than 0.7 (Burch, Steel & Hemsley, 1988). High internal consistency has also been reported for Unusual Experiences ($\alpha = 0.89$); Cognitive Disorganisation ($\alpha = 0.87$); Introvertive Anhedonia ($\alpha = 0.82$) and Impulsive Nonconformity ($\alpha = 0.77$). The construct validity of the O-LIFE has been established through its use in a variety of studies across different research domains (see Mason & Claridge, 2006 for review).

3.2.2 Theory of Mind Tasks

Two measures of ToM were used.

3.2.2.1 The Eyes Test (Baron-Cohen, Wheelwright, Hill, Raste & Plumb, 2001)

In this test of ToM (see Appendix 3 for example), participants were presented with 36 photographs of the eye-region of faces. Each photograph is surrounded by four words. Participants were asked to choose which word best describes the mental state of the person in the picture. If they were unsure of a term, participants were able to consult a glossary of terms. The total score consists of the number of correct responses, ranging from 0 to 36. No reliability data for this measure are reported. It has however been used to distinguish high functioning adults with autism from controls (Baron-Cohen et al., 2001).

3.2.2.2 Picture-Story Sequencing Task (Langdon & Coltheart, 1999)

Participants were presented with four pictures in a pre-determined order and were asked to arrange them into a story that shows a logical sequence (see Appendix 4 for examples). There were four story types: False Belief, Social Script, Mechanical and Capture. Accurate sequencing of the False Belief stories required appreciation of a story character's false belief, so these stories assessed ToM. The Social Script stories depicted people acting out everyday social scenarios (such as doing the shopping), which did not require inferring beliefs or intentions. The Mechanical stories (such as a boulder rolling down a hill) controlled for physical cause-and-effect reasoning. The Capture stories portrayed people in everyday situations where a highly salient, misleading cue had to be inhibited if participants were to take account of other less salient story details necessary to correctly sequence the story. In this respect, the capture stories controlled for inhibitory suppression. The Capture stories were also designed to be more difficult than the False Belief stories, so as to control for possible ceiling effects with performance on the False Belief stories.

The task was administered and scored according to the instructions outlined in Langdon & Coltheart (1999). Each set of stories received a score ranging between 0 and 6. Two points were awarded if the first or last card was in the right position. One point was awarded if the second or third card was in the right position. Responses were timed.

3.2.3 Context Processing Tasks

Two context processing tasks were chosen in which contextual processing deficits were expected to result in enhanced performance as contextual information in these tasks is misleading.

3.2.3.1 The Hidden Figures Test (Ekstrom, French, Harman & Dermen, 1976)

In this task (see Appendix 5 for example), participants were presented with five simple figures that were available throughout the task, and thirty-two complex figure problems. The aim of the task was to identify which one of the five simple figures was hidden in each of the complex figures. Participants were given a maximum time of 24 minutes to complete the task. Contextual information in the complex figures is distracting, so it was anticipated that contextual processing deficits would lead to enhanced performance. The total score consists of the number of correct responses, ranging from 0 to 32. No psychometric data are reported for this measure.

3.2.3.2 Block Design Sub-Scale of the WASI (Psychological Corporation, 1999)

In this task, participants were presented with target figures comprising red and white segments. They were required to recreate the target figure using blocks made up of red and white segments. The raw score is a function of accuracy and reaction time, ranging between 0 and 71. Raw scores were converted into standardised T scores. The WASI manual (Psychological Corporation, 1999) reported good split test reliability (ranging from 0.9 and 0.94); test-retest reliability (0.92) and good inter-rater

reliability (in the high 0.90s). In terms of validity, the WASI manual reported good convergent validity (0.83) between the Block Design sub-scale of the WASI and the WAIS III (WAIS-III; Wechsler, 1997).

3.2.4 Thought Disorder Index (TDI): Short Form (Carpenter et al., 1993)

The full version of the TDI was developed by Johnston & Holzman (1979) as a way of classifying and measuring instances of disordered thinking. The short form of the TDI derives estimates of thought disorder with four Rorschach cards that are comparable to the full 10-card version. The four Rorschach cards used were, II, IV, VI and IX from the full version of the index. These were chosen because they had the strongest associations with the 'Peculiar Verbalisations and Responses' category of the 10-card version (Carpenter et al., 1993), and such responses have been shown to be the most common thought disordered responses in non-clinical populations (Coleman, Levy, Lenzenweger & Holzman, 1996).The short form of the TDI was administered according to the instructions outlined by Rapport, Gill & Shafer (1968), consisting of a response and inquiry stage.

Participants were presented with each Rorschach card and responses to the question "what might this be" were audio-recorded. If participants did not respond, a series of increasingly concrete questions were asked, such as "What does it look like to you?" and "Is there anything on this card which reminds you of anything?" After each response, participants were prompted to check if they had any other ideas before the card was turned over. When the card was turned over, the inquiry stage was conducted, in which an explanation of participants' responses was elicited. This was

done in accordance with the recommendations made by Solovay et al. (1986) in which a naïve stance was adopted by the examiner to clarify responses without leading the participant.

Once responses had been audio-recorded, they were transcribed verbatim. The transcriptions were then coded according to the scoring manual for the TDI (Solovay et al., 1986). This distinguishes 23 qualitative categories of thought disturbance associated with four levels of severity: 0.25 level, 0.50, 0.75 and 1.00, with 0.25 representing the mildest forms and 1.00 the severest forms of thought disorder. Once incidents of thought disorder had been classified and rated, a TDI index score was calculated, based on the sum of severity scores divided by the total number of Rorschach responses.

Johnston & Holzman (1979) reported good inter-rater reliability for the full 10 card version of the TDI ($r = 0.82$ to 0.93). The full 10 card version has also demonstrated good predictive validity in predicting psychotic symptoms in patients with borderline and schizotypal personality disorders (O'Connell, Cooper, Perry & Hoke, 1989) and has also been used to measure neuroleptic induced reductions of thought disorder in individuals with schizophrenia (Hurt, Holzman & Davies, 1983).

In order to determine reliability, 40 transcripts (from those with even participant numbers) were second-rated. It was not straightforward counting the total number of Rorschach responses, as where one response ended and another began involved a degree of subjectivity. In this respect, the interclass correlation for the total number of Rorschach responses was calculated (0.81). The percentage co-occurrence of the

categorical variables was calculated as 79% (see part 3, critical review for more discussion on this).

3.2.5 Control Tasks

Three control tasks were administered to account for the possibly confounding influences of executive functioning, non-verbal IQ and verbal IQ.

3.2.5.1 The Brixton Test (Burgess & Shallice, 1997)

In this non-verbal test of executive functioning, participants were presented with a booklet of 54 cards each with a pattern of nine open circles and one blue circle. The location of the blue circle changes on each succeeding card according to patterns that can change without warning. Participants were instructed to indicate where s/he thought the blue circle would be on the next card. The raw score is based on the number of errors made. Raw scores ranging from 0 to 54 were converted to a scaled score of 1 to 10, with 10 indicating 0-7 errors and being classified as "very superior", and 1 indicating over 31 errors and being classified as "impaired". Burgess & Shallice (1997) reported high test-retest reliability (r=0.71) as well as good split-test reliability (r=0.62) on this test.

3.2.5.2 Test of Non-Verbal Intelligence, 3rd Edition (TONI-3: Brown, Sherbenou & Johnsen, 1998)

This test was used to control for non-verbal IQ. Participants were asked to solve 50 problems by identifying relationships among abstract figures and discovering the rule that governed that relationship. Each item presented a set of figures with one part missing. Participants were given a set of response alternatives from which s/he had to select the correct part to complete the pattern. The TONI-3 is distinguished from the context processing tasks as it primarily involves logical rather than perceptual processes. The raw score is based on the total number of correct items, ranging from 0 to 50, which were transformed into deviation quotients, with a mean of 100 and standard deviation of 15. Brown et al. (1998) reported good split-half reliability for different age groups (all equal or exceeding 0.89); good test-retest reliability (0.9) and inter-rater reliability (0.96). In terms of validity, Brown et al. (1998) reported correlations between the TONI-3 and the Verbal Scale IQ (0.51), Performance Scale IQ (0.76) and Full Scale IQ (0.71) of the WAIS-R (Psychological Corporation, 1981).

3.2.5.3 Vocabulary and Similarities Sub-Scales of the Wechsler Abbreviated Scale of Intelligence (WASI: Psychological Corporation, 1999))

In order to control for verbal IQ when assessing thought disorder, the Vocabulary and Similarities sub-scales of the WASI were administered. In Vocabulary, participants were asked to explain the meaning of a list of 42 increasingly difficult words. In Similarities, participants were asked to identify the increasingly complex relationship between 26 pairs of words. For both sub-scales, responses were awarded a score of 0,

1, 2 or 3 based on the scoring criteria in the manual. Raw scores were the total number of correct responses, ranging from 0 to 80 for Vocabulary and 0 to 48 for Similarities. Raw scores for the Vocabulary and Similarities sub-scales were converted into a verbal IQ score, with a mean of 100 and a standard deviation of 15. The WASI manual (Psychological Corporation, 1999) reported good split test reliability (ranging from 0.9 to 0.98 for Vocabulary and 0.84 to 0.96 for Similarities); good test-retest reliability (0.87 for Vocabulary and 0.85 for Similarities) and good inter-rater reliability (0.98 for Vocabulary and 0.99 for Similarities). In terms of validity, the WASI manual also reported good convergent validity with the Vocabulary and Similarities sub-scales of the WAIS III (0.72 and 0.69 respectively).

3.3 Procedure

Participants were given written information about the study (see Appendix 6) and were given the opportunity to ask questions. After giving written, informed consent to take part (see Appendix 6), participants were individually administered the 10 tasks in the order below in a quiet room:

1) O-LIFE; 2) Eyes Test; 3) Hidden Figures Test; 4) Brixton 5) TONI-3;
6) Vocabulary; 7) Block Design; 8) Similarities; 9) Picture-Story Sequencing Task;
10) TDI

For each participant, the tasks took an average of 2 hours to complete. Participants were paid £12 for taking part.

3.4 Ethics

The study was approved by the University College London Research Ethics Committee (see Appendix 7)

4. Results

4.1 Schizotypy Scales

Table 1 describes the means and standard deviations (SD) from the normative samples for the O-LIFE (Mason et al., 2006) and STA (Joseph & Peters, 1995) and the means, standard deviations and range of scores from the current study.

Table 1:

Normative sample mean (SD), current study mean (SD) and range of questionnaire scores for the whole sample (N=80)

Scale	*Normative Sample Mean (SD)*	*Current Study Mean (SD)*	*Current Study Range*
STA	10.45 (3.6)	14.33 (7.03)	1-28
O-LIFE Total Score	22.62 (20.64)	35.67 (13.07)	10-67
O-LIFE Unusual Experiences (UE)	8.82 (6.16)	9.33 (7.22)	0-26
O-LIFE Cognitive Disorganisation (CD)	10.73 (5.87)	12.35 (5.71)	0–24
O-LIFE Introvertive Anhedonia (IA)	6.38 (4.49)	5.49 (4.57)	0-23
O-LIFE Impulsive Non-Conformity (IN)	7.69 (4.12)	8.44 (3.28)	0-15

Two scores on the IA sub-scale were considered outliers and excluded from further analysis as they were more than three standard deviations above the mean (z = 3.83 and 3.39).

Raw scores on the O-LIFE were converted to standard scores for analysis using Mason et al.'s (2006) sex and age norms (standard score = raw score – norm mean score/ SD). The total O-LIFE standard score was then the sum of the standard scores for each sub-scale. The standardised IA and UE scores were then corrected for a severe positive skew through the application of $\log_{10}$ transformations

4.2 IQ and Executive Functioning Test Scores

Table 2 describes the means, standard deviations (SD) and range of scores for the tests of Non-Verbal IQ, Verbal IQ and executive functioning.

Table 2:

Mean (SD) and range scores on tests of IQ and executive functioning

Test	*Mean (SD)*	*Range*
Non-Verbal IQ (TONI-3)	102.96 (10.55)	83-130
Verbal IQ (WASI)	113.76 (11.19)	86-142
Executive Functioning (Brixton)	7.25 (1.7)	4-10

The scores for the above tests were normally distributed and contained no outliers. Correlations revealed no significant associations between the O-LIFE total standard score and executive functioning ($r = -0.054$; $p = 0.316$) or verbal IQ ($r = 0.27$; $p = 0.410$). However, O-LIFE total standard score was significantly correlated with Non-Verbal IQ ($r = -0.191$; $p = 0.045$), indicating that high scores on the O-LIFE were associated with poorer non-verbal IQ.

4.3 Theory of Mind Tasks

Two position scores for the False Belief stories were considered outliers and removed, both with Z scores of -3.34. False Belief position scores were then corrected for a severe negative skew through the application of a $\log_{10}$ transformation after scores had been reflected.

One score on the Eyes Test was considered an outlier and removed (Z = -3.74). Scores on the Eyes test were then corrected for a moderate negative skew through the application of a square root transformation after scores had been reflected.

4.3.1 Correlations between ToM Tasks

In order to assess if the Eyes Test and the False Belief stories in the Langdon & Coltheart (1999) task were assessing the same construct, transformed scores for the False Belief stories were correlated with the transformed scores for the Eyes Test (N= 77). There was no significant association ($r = 0.03$; $p = 0.81$), indicating that they do not have a significant amount of shared variance and are likely to measure different aspects of ToM. An aggregate measure of ToM was thus not calculated.

4.4 Hypothesis 1: High schizotypes will have a lower position score on the False Belief stories task than low schizotypes, but similar performance on the other story types

Two position scores for the Social Script and Physical stories were considered outliers and removed (Z = -3.68 and -3.7 respectively). There were no outliers for the Capture scores, and those for the False Belief scores are described above. Scores for the Social Script and Physical stories were then corrected for a severe negative skew through the application of $\log_{10}$ transformation after scores had been reflected.

Participants were divided into two groups, 'high schizotypes' and 'low schizotypes', based on the median split of the O-LIFE total standard score (median = -0.4251). Table 3 summarises the mean untransformed position scores for each of the four story types for high and low schizotypes.

Table 3:

Mean (SD) position scores for each of the four story types

Story Type	*Low Schizotypes Mean (SD)*	*High Schizotypes Mean (SD)*
Social Script	5.78 (0.41)	5.63 (0.51)
Mechanical	5.54 (0.59)	5.43 (0.77)
Capture	4.15 (0.1)	4.3 (1.1)
False Belief	5.19 (0.64)	5.18 (0.81)

A repeated measures ANOVA was conducted with position scores for the Capture stories and transformed scores for the other three stories as the dependent variables, and the median split of the O-LIFE total standard score as the grouping factor. Contrary to Langdon & Coltheart (1999), there was no significant effect of schizotypy

(F (1, 73) = 0.73; p = 0.4). There was a significant effect of story type (F (3, 73) = 1004.42; p = <0.001). This was not investigated further as the effect of story type across participants as a whole was not considered relevant to the study hypotheses. The interaction between schizotypy and story type was not significant (F (3, 73) = 0.28; p = 0.84).

4.5 Hypothesis 2: High schizotypes will take longer to correctly sequence False Belief stories than low schizotypes

Table 4 shows the mean reaction times to correctly sequence each of the four story types.

Table 4:

Reaction time (sec) to correctly sequence stories

Story Type	*Low Schizotypes Mean (SD)*	*High Schizotypes Mean (SD)*
Social Script	13.35 (3.3)	13.14 (3.64)
Mechanical	15.76 (5.68)	15.61 (5.42)
Capture	29.29 (14.0)	28.17 (11.0)
False-Belief	20.74 (8.41)	18.81 (6.29)

One False Belief reaction time (z = 3.82), one Mechanical reaction time (z = 6.85) and two Social Script reaction times (both z = 3.19) were considered outliers and removed from the analysis. One participant did not correctly sequence any False Belief stories and five participants did not correctly sequence any Capture stories and were thus not included in the analysis. Reaction time data for all four story types were characterised by a severe positive skew and were corrected through the application of Log_{10} transformations.

A repeated measures ANOVA was conducted, with transformed reaction times for the four story types as the dependent variables, and the median split of the O-LIFE total standard score as the grouping factor (N = 74). There was no significant effect of schizotypy ($F(1, 67) = 0.15$; $p = 0.7$). There was a significant effect of story type ($F(3, 67) = 115.8$; $p = <0.001$). As before, this was not investigated further as reaction times to the stories overall were not relevant to the study hypotheses. There was no significant interaction between schizotypy and reaction times ($F(3, 67) = 0.34$; $p = 0.8$).

4.6 Hypothesis 3: High schizotypes will perform worse on the Eyes Test than low schizotypes

Table 5 shows scores on the Eyes Test for high and low schizotypes.

Table 5:

Eyes test performance

Low Schizotypes Mean (SD)	*High Schizotypes Mean (SD)*
28.13 (3.28)	27.68 (3.04)

An independent samples t test (N = 79) showed that there was no significant difference between the two groups ($t(75) = -0.76$; $p = 0.45$).

4.7 Hypothesis 4: Cognitive Disorganisation will predict impaired performance on the False Belief stories and the Eyes Test independently of IQ and executive functioning

Two separate multiple regression analyses were performed in three successive steps with transformed False Belief position scores (N = 78) and transformed Eyes Test scores (N = 79) as the dependent variables. At the first and second steps, non-verbal IQ and executive functioning respectively were entered into the regression equations as predictor variables. At the third step, standardised scores for the CD and IN scales and transformed standard scores for the UE and IA scales of the O-LIFE were entered into the regression equation as predictor variables. For each analysis the assumptions of linearity, homoscedasticity, independent errors and normally distributed errors necessary for regression (Berry, 1993) were met.

4.7.1 False Belief Stories

The overall equation for the first step ($F(1, 74) = 4.5$; $p = 0.037$) accounted for 5.7% of the total variance. The overall equation for the second step ($F(2, 73) = 2.6$, $p = 0.081$), accounted for 6.7% of the total variance. The overall equation for the third step ($F(6, 75) = 2.1$, $p = 0.064$), accounted for 15.5% of the total variance. Table 6 presents the regression coefficients for the predictor variables. Scores for the UE and CD sub-scales were negatively associated with ToM performance, but not significantly so. Contrary to the predictions of the study, Introvertive Anhedonia and Impulsive Non-Conformity were positively associated with ToM performance. This association was approaching significance for the IA sub-scale, indicating that as IA

scores increased by one standard deviation (0.146), False Belief performance increased by 0.248 standard deviations.

Table 6:

Non-verbal IQ, executive functioning and O-LIFE standard sub-scale scores as predictors of position scores on the False Belief Stories Task

Predictor Variable	*B*	*SEB*	*Beta*	*t*	*p*
Non-Verbal IQ	0.004	0.002	0.239	3.315	0.01
Executive Functioning	0.01	0.012	0.101	0.853	0.396
O-LIFE UE	-0.085	0.117	- 0.099	-0.724	0.472
O-LIFE CD	-0.039	0.024	-0.239	-1.606	0.113
O-LIFE IA	0.286	0.147	0.248	1.945	0.056
O-LIFE IN	0.001	0.025	0.001	0.005	0.996

4.7.2 Eyes Test

The overall equations for the first step ($F(1, 75) = 0.7$, $p = 0.41$); second step ($F(2, 74) = 0.35$, $p = 0.7$) and third step ($F(6, 70) = 0.58$, $p = 0.75$) were not significant. Table 7 shows the regression coefficients for the predictor variables.

Table 7:

Non-verbal IQ, executive functioning and O-LIFE standard sub-scale scores as predictors of the number of correct responses on the Eyes Test

Predictor Variable	*B*	*SEB*	*Beta*	*t*	*p*
Non-Verbal IQ	0.006	0.007	0.096	0.834	0.407
Executive Functioning	-0.006	0.045	-0.17	-0.141	0.888
O-LIFE UE	-0.509	0.442	-0.166	1.152	0.253
O-LIFE CD	0.053	0.095	0.086	0.556	0.580
O-LIFE IA	-0.682	0.556	-0.164	1.226	0.224
O-LIFE IN	0.037	0.092	0.051	0.398	0.692

4.8 Context Processing Tasks

Block Design scores were transformed to correct for a moderate negative skew through the application of a square root transformation after scores had been reflected. Scores on the Hidden Figures Test were normally distributed.

4.8.1 Correlations between Context Processing Tasks

Transformed Block Design scores and Hidden Figures Test scores were significantly correlated ($r = 0.63$; $p = <0.001$). This correlation remained significant when non-verbal IQ and executive functioning were co-varied ($r = 0.56$; $p = 0.01$), indicating that there was a significant amount of shared variance. A composite context processing task score was calculated based on Z scores.

4.9 Hypothesis 5: High schizotypes will perform significantly better on Block Design and the Hidden Figures Test compared to low schizotypes

4.9.1 Block Design

Table 8 shows Block Design scores for high and low schizotypes.

Table 8:

Block Design test performance

Low Schizotypes Mean (SD)	*High Schizotypes Mean (SD)*
57.67 (6.27)	57.5 (8.94)

An independent samples t test showed that there was no significant difference between the two groups ($t(75) = 0.37$; $p = 0.34$).

4.9.2 Hidden Figures Test

Table 9 shows Hidden Figures scores for high and low schizotypes.

Table 9:

Hidden Figures test performance

Low Schizotypes Mean (SD)	*High Schizotypes Mean (SD)*
14.58 (7.93)	14.51 (8.74)

An independent samples t test with scores on the Hidden Figures Test as the dependent variable and high versus low schizotypy as the grouping variable showed

that there were no significant differences between the two groups (t (76) = 0.041; p = 0.484)).

4.9.3 Composite Context Processing Task Score

Table 10 shows the composite context processing task scores for high and low schizotypes.

Table 10:

Composite context processing task scores

Low Schizotypes Mean (SD)	*High Schizotypes Mean (SD)*
-0.0001 (0.79)	-0.0227 (1.022)

An independent-samples t test with composite context processing score as the dependent variable and high versus low schizotypy as the grouping variable showed that there were no significant differences between the two groups (t (75) = 0.109; p = 0.457).

4.10 Hypothesis 6: Cognitive Disorganisation will predict enhanced performance on the Block Design and Hidden Figures Test independently of IQ and executive functioning.

Two multiple regression analyses identical to that described above for hypothesis 4 were conducted with transformed Block Design scaled scores and Hidden Figures Test scores as the dependent variables. A third analysis was also conducted with the composite context processing task score as the dependent variable. For each analysis

the assumptions of linearity, homoscedasticity, independent errors and normally distributed errors necessary for regression (Berry, 1993) were met.

4.10.1 Block Design

The overall equations for the first step ($F(1, 75) = 11.9$, $p = 0.001$), second step ($F(2, 74) = 7.16$, $p = 0.001$) and third step ($F(6, 70) = 2.72$, $p = 0.02$) were all significant, accounting for 13.7%, 16.2% and 18.9% of the total variance respectively. Table 11 presents the regression coefficients for the predictor variables. Contrary to expectations, Cognitive Disorganisation was negatively associated with Block Design performance, although only non-verbal IQ made a significant independent contribution to Block Design score.

Table 11:

Non-verbal IQ, executive functioning and O-LIFE standard sub-scale scores as predictors of Block Design performance

Predictor Variable	*B*	*SEB*	*Beta*	*t*	*p*
Non-Verbal IQ	0.04	0.01	0.37	3.45	0.001
Executive Functioning	0.11	0.07	0.17	1.5	0.14
O-LIFE UE	0.3	0.73	0.05	0.41	0.68
O-LIFE CD	-0.22	0.16	-0.2	-1.41	0.16
O-LIFE IA	1.07	0.92	0.14	1.16	0.25
O-LIFE IN	0.06	0.15	0.05	0.4	0.7

4.10.2 Hidden Figures Test

The overall equations for the first (F (1, 76) = 14.74, p = <0.001), second (F (2, 75) = 8.75, p = <0.001) and third steps (F (6, 71) = 3.48, p = 0.004) were significant, accounting for 15%, 16% and 18% of the total variance respectively. Table 12 shows the regression coefficients for the predictor variables. Contrary to the predictions of the study, the regression slopes for the Cognitive Disorganisation and Impulsive Nonconformity sub-scales were negative, indicating that an average increase in each of them was associated with a decrease in Hidden Figures Test performance. The regression slopes for the Unusual Experiences and Intorvertive Anhedonia subscales were positive. However, only non-verbal IQ made a significant independent contribution to Hidden Figures Test performance.

Table 12:

Non-verbal IQ, executive functioning and O-LIFE standard sub-scale scores as predictors of the number of correct responses on the Hidden Figures Test

Predictor Variable	*B*	*SEB*	*Beta*	*t*	*p*
Non-Verbal IQ	0.31	0.08	0.4	3.83	<0.001
Executive Functioning	0.79	0.54	0.16	1.48	0.14
O-LIFE UE	0.362	0.89	0.1	0.41	0.69
O-LIFE CD	-1.5	1.13	-0.184	-1.33	0.188
O-LIFE IA	5.36	3.76	0.17	1.43	0.16
O-LIFE IN	-0.87	1.12	-0.09	-0.77	0.44

4.10.3 Composite Context Processing Tasks Scores

The overall equations for the first step ($F(1, 75) = 16.9$, $p = <0.001$), second step ($F(2, 74) = 10.12$, $p = <0.001$) and third step ($F(6, 70) = 4.12$, $p = 0.01$) were all significant, accounting for 18.4%, 21.5% and 26.1% of the total variance respectively. Table 13 shows the regression coefficients for the predictor variables. Contrary to expectations, Cognitive Disorganisation was negatively associated with the composite score on the context processing tasks, although as before, only non-verbal IQ made a significant independent contribution to the composite context processing task score.

Table 13:

Non-verbal IQ, executive functioning and O-LIFE standard sub-scale scores as predictor variables for scores on the composite context processing task

Predictor Variable	*B*	*SEB*	*Beta*	*t*	*p*
Non-Verbal IQ	0.04	0.01	0.43	4.11	<0.001
Executive Functioning	0.01	0.06	0.19	1.7	0.09
O-LIFE UE	0.33	0.57	0.72	0.58	0.57
O-LIFE CD	-0.21	0.12	-0.23	-1.69	0.1
O-LIFE IA	1.09	0.72	0.18	1.51	0.14
O-LIFE IN	-0.06	0.12	-0.6	-0.54	0.5

4.11 Hypothesis 7: Performance on the ToM and context processing tasks will be inversely related.

As described in table 14, correlations were performed between task performance on the context processing and ToM tasks covarying for non-verbal IQ and executive functioning. None of the associations were significant.

Table 14:

Correlations between context processing & ToM tasks co-varying for non-verbal IQ and executive functioning

	Hidden Figures	*Block Design*	*Composite Context Processing Score*
Eyes Test	r = 0.03 p = 0.4	r = 0.08 p = 0.24	r = 0.02 P = 0.43
False Belief Story Task Position Score	r = 0.05 p = 0.32	r = -0.001 p = 0.5	r = 0.01 p = 0.45

4.12 Thought Disorder

75 participants were assessed for thought disorder. Table 15 shows the total frequencies of categories identified with their corresponding degree of severity. The mean thought disorder index (TDI) score was 0.08 (SD = 0.08). The minimum value was 0, and the maximum was 0.36.

Table 15:

Categories & frequencies of thought disorder found

Category (severity level)	*Frequency*
Peculiar Verbalisations & Responses (0.25)	85
Inappropriate Distance (0.25)	80
Vagueness (0.25)	11
Incongruous Combinations (0.25)	8
Flippant Response (0.25)	2
Tendency to Looseness (0.25)	3
Tendency to Confusion (0.25)	3
Confusion (0.5)	3
Fragmentation (0.5)	2

Two TDI scores were considered outliers and removed (Z = 3.18 and 3.26). TDI scores were then corrected for a reverse J distribution by dividing one by each score. After this transformation the TDI scores were still considered too skewed (z = 3), so non-parametric methods were used when TDI scores were the dependent variable.

The median split of the TDI scores (0.24) was used to create high and low TDI groups. Table 16 shows mean scores and standard deviations for the two groups in relation to verbal IQ, non-verbal IQ, executive functioning, total O-LIFE standard score and Cognitive Disorganisation scores on the O- LIFE. Two-tailed independent-samples t tests with high versus low TDI as the grouping factor (N = 73) showed that this difference was not significant for verbal IQ ($t(74) = 0.172$; $p = 0.63$); non-verbal IQ ($t(78) = -0.12$; $p = 0.91$); total O-LIFE standard score ($t(76) = 0.43$; $p = 0.67$) or Cognitive Disorganisation ($t(78) = 1.39$; $p = 0.17$). The low TDI group had lower executive functioning scores than the high TDI group, and this difference approached significance ($t(78) = -1.81$; $p = 0.074$). Executive functioning could relate to the TDI score as the latter is calculated by dividing the number of incidents of thought

disorder by the total number of ideas generated. This is unlikely to effect interpretation of the current findings as better executive functioning was associated with higher levels of thought disorder.

Table 16:

High and Low TDI groups in relation to verbal IQ, on-verbal IQ, executive functioning, total O-LIFE standard score and Cognitive Disorganisation standard Score

Domain	*High TDI Mean (SD) N = 37*	*Low TDI Mean (SD) N = 38*
TDI	0.15 (0.07)	0.021 (0.02)
Verbal IQ	113.18 (10.12)	114.42 (12.38)
Non-Verbal IQ	103.1 (11.0)	102.82 (10.17)
Executive Functioning	7.57 (1.7)	6.89 (1.64)
Total O-LIFE Standard Score	-0.33 (2.87)	-0.06 (2.59)
Cognitive Disorganisation Standard Score	0.01 (1.09)	0.32 (0.91)

4.13 Hypothesis 8: High schizotypes with high thought disorder will have significantly more impaired performance on the ToM tasks than low schizotypes with low thought disorder.

Participants were allocated to one of four groups described in table 17 based on the median split of their total O-LIFE score and the median split of the TDI scores (0.24). A Kruskal-Wallis test with TDI scores as the dependent variable (N = 75) showed that there was a significant difference between the four groups (χ^2 (3) = 56.26; p = <0.001). The comparison of most interest to assess was between the low schizotypy group low in thought disorder and the high schizotypy group high in thought disorder. A Mann-Whitney U test showed that this difference was significant (z = -5.01; p = 0.001).

Table 17:

TDI scores for the four schizotypy-thought disorder groups

Group	*N*	*TDI Mean (SD)*
Low schizotypy-low thought disorder	18	0.18 (0.18)
Low schizotypy-high thought disorder	20	0.15 (0.08)
High schizotypy-low thought disorder	20	0.02 (0.22)
High schizotypy-high thought disorder	17	0.14 (0.07)

Table 18 shows the scores on the ToM tasks for each of the four groups.

Table 18:

Eyes Test performance and False Belief Story position score by schizotypy-thought disorder group

Group	*N*	*False Belief Stories Mean (SD)*	*Eyes Test Score Mean (SD)*
Low schizotypy-low thought disorder	18	5.07 (0.71)	27.89 (2.87)
Low schizotypy-high thought disorder	20	5.21 (0.63)	28.2 (3.47)
High schizotypy-low thought disorder	20	5.32 (0.89)	27.32 (3.18)
High schizotypy-high thought disorder	17	5.16 (0.63)	27.94 (3.1)

An ANOVA with transformed scores on the ToM tasks as the dependent variable and schizotypy-thought disorder as the grouping variable showed that there were no significant differences in False Belief position scores ($N = 75$) ($F(3,69) = 0.68$, $p = 0.57$) or the Eyes Test ($N = 75$) ($F(3,70) = 0.34$, $p = 0.8$).

4.14 Hypothesis 9: High schizotypes with high thought disorder will have significantly better performance on the context processing tasks than low schizotypes with low thought disorder

Table 19 shows the Block Design, Hidden Figures Test and composite context processing task scores for each of the four schizotypy-thought disorder groups.

Table 19:

Context processing task performance by schizotypy-thought disorder group

Group	*N*	*Block Design Mean (SD)*	*Hidden Figures Test Mean (SD)*	*Composite Context Processing Task Score Mean (SD)*
Low schizotypy-low thought disorder	18	56.83 (5.83)	14.1 (7.2)	-0.08 (0.68)
Low schizotypy-high thought disorder	20	59.6 (5.92)	16.15 (9.07)	0.22 (0.87)
High schizotypy-low thought disorder	20	57.53 (10.07)	16.0 (10.04)	0.07 (1.24)
High schizotypy-high thought disorder	17	57.82 (7.9)	12.0 (6.83)	-0.15 (0.78)

An ANOVA with transformed scaled Block Design scores as the dependent variable showed there were no significant differences between the four schizotypy-thought disorder groups ($F(3,70) = 4.83$, $p = 0.7$). Similarly, there were no significant group differences when Hidden Figures Test scores ($F(3, 71) = 0.96$, $p = 0.42$) and the composite context processing task scores ($F(3, 70) = 0.6$, $p = 0.62$) were the dependent variables.

5. Discussion

Individuals with schizophrenia and non-clinical individuals high in schizotypy have been shown to have impaired ToM and impaired context processing. The current

study explored links between these two deficits using the schizotypy paradigm in light of research suggesting that impaired ToM is best understood as a consequence of pervasive difficulties in the co-ordination of contextually relevant information (Phillips & Silverstein, 2003). Based on the existing literature, nine hypotheses were generated that aimed to replicate and extend previous findings using a range of established measures. The non-significant findings of this study are discussed below in relation to three main areas: i) overall ToM and context processing performance, ii) analogue symptom profiles and iii) thought disorder.

5.1 Overall ToM and Context Processing Performance

5.1.1 ToM

Two measurements of ToM were used: a False Belief Picture-Story sequencing task (Langdon & Coltheart, 1999) and the Eyes Test (Baron-Cohen et al., 2001). It was predicted that high total schizotypy scores, as measured by the O-LIFE, would be associated with impaired ToM. Contrary to expectations, high total schizotypes were not significantly more impaired at sequencing the False Belief stories than low schizotypes as reported by Langdon & Coltheart (1999).

The present study was the first to investigate performance on Langdon & Coltheart's (1999) story task using the O-LIFE. Langdon & Coltheart (1999) divided participants into high and low schizotypy groups using the median split of the Schizotypal Personality Questionnaire (SPQ) (Raine, 1991), which might be cited as one reason for the differences observed between the two studies. Pickup (2006) also failed to find

a significant difference between high and low schizotypes on ToM performance using Fletcher et al.'s (1995) story task when the median split of the O-LIFE was used. Pickup (2006) noted that the SPQ is more similar to the Unusual Experiences (UE) sub-scale of the O-LIFE than the O-LIFE as a whole, which explained why a regression analysis indicated that high scores on the UE sub-scale predicted poorer ToM when verbal IQ and executive functioning were controlled for. The current study found that scores on the UE sub-scale were inversely associated with position scores for the False Belief stories, but they were not a significant predictor of performance. It is unlikely that this reflects a restricted range of scores on the UE sub-scale because a good range of scores was achieved in the present study, and the means and standard deviations were similar to those achieved in the normative sample (Mason et al., 2006). Equally, insufficient statistical power is not a possible explanation, as Langdon & Coltheart (1999) found significant results with sample sizes of 40 and 28 in the first and second parts of their study respectively.

The only significant predictor of performance on the False Belief stories in the current study was non-verbal IQ. There were no significant differences between high and low schizotypes on the 'Capture' stories (which were more difficult than the False Belief stories) in the current study or in Langdon & Coltheart's (1999) study. The inclusion of these stories was designed to discount the possibility of poor performance on the False Belief stories resulting from task difficulty rather than impaired ToM. However, Langdon & Coltheart (1999) did not separately control for IQ, and it is possible that the group differences they found on the False Belief stories were influenced by the interaction between IQ and ToM that was found to be important in the present study. Further studies using Langdon & Coltheart's (1999) task with non-clinical

participants varying in schizotypy and co-varying for IQ would be beneficial to check if their findings are replicable.

No published studies have explored ToM in schizotypy using the Eyes Test. The current study did not find any significant differences in performance between high and low total schizotypes. Uhlhaas et al. (2006) reported impaired performance on the Eyes Test in a sample of individuals with schizophrenia compared to controls. They also calculated a composite score from performance on the Eyes Test, the Sally-Anne task (Wimmer & Perner, 1983) and Hinting Task (Corcoran, Mercer & Frith, 1995), which suggests that performance on these tasks was related. The Eyes Test and the False Belief stories in the current study did not have a significant amount of shared variance, indicating that they are likely to measure different aspects of ToM when given to healthy individuals. This highlights that ToM is a multi-faceted construct. A factor analytic investigation into performance on the variety of ToM tasks that exist would be helpful in determining the factor structure of the construct.

5.1.2 Context Processing Tasks

It was predicted that high total schizotypes would be significantly better at Block Design and the Hidden Figures Test than low total schizotypes as contextual processing deficits were expected to provide an advantage on tasks where context was misleading. Contrary to the study predictions, high schizotypy was associated with poorer performance on both context processing tasks. The present study was the first to examine Block Design performance and schizotypy. Block Design has previously been shown to be enhanced in autism relative to matched controls (Shah & Frith,

1993) and preserved in schizophrenia relative to deficits on other subtests (Green & Walker, 1985), or the performance of controls (Robertson & Taylor, 1985). It is possible that this preserved rather than enhanced ability in schizophrenia reflects a weak effect of context processing deficits on Block Design task performance in the disorder (Pickup, 2000). This might explain why there was no significant relationship found between Block Design performance and schizotypy in the present study, where any effect may be less marked than in clinical groups.

The present study included a direct replication of Tsakanikos & Reed's (2003) study. Tsakanikos & Reed (2003) reported that impaired performance on the Hidden Figures Test was significantly associated with the Inrovertive Anhedonia subscale of the O-LIFE and that enhanced performance was significantly associated with the Impulsive Nonconformity subscale. Compared to the present study, Tsakanikos & Reed (2003) had different predictions, and interpreted their findings from a different theoretical framework, which is considered more fully in the critical appraisal. The present study found no significant associations between the O-LIFE and performance on the Hidden Figures Test. Although Tsakanikos & Reed (2003) had a sample of one-hundred participants, the non-significant findings of the current study on the Hidden Figures Test cannot be explained due to insufficient power. An a-priori power analysis with a large effect size of 0.35, based on the significant effect size of 0.37 reported by Tsakanikos & Reed (2003), indicated that only 46 participants were required. The similar mean scores on the sub-scales of the O-LIFE in the two studies also discounts an explanation based on different distributions of sub-scale scores. Although Tsakanikos & Reed (2003) did not control for executive functioning, this cannot explain the contrasting results as the current study found executive functioning did

not significantly predict Hidden Figures Test performance. It is difficult to establish other possible reasons for the non-significant findings on the Hidden Figures Test, but they suggest the necessity for replication of Tsakanikos & Reed's (2003) study before any conclusions can be more confidently drawn from them.

5.2 Relationships between Tasks & Symptom Profiles

Performance on the ToM and context processing tasks was expected to be inversely related, reflecting the respective disadvantages and advantages conferred on task performance by impaired co-ordination of contextually relevant information (Phillips & Silverstein, 2003). Using a sample of individuals with schizophrenia, such a pattern was reported by Uhlhaas, Phillips, Schenkel & Silverstein (2006) and Schenkel, Spaulding & Silverstein (2005), suggesting that ToM represents a social cognitive form of context processing rather than a domain specific module. The current study did not find any statistically significant associations between performance on the context processing and ToM tasks. There are two main explanations for this. Firstly, it is possible that impaired context processing and impaired ToM are not related in healthy individuals, and a modular based explanation of ToM is the most appropriate. Alternatively, it could be that the characteristics of the particular tasks used were not sensitive to subtle levels of impaired context processing.

Phillips & Silverstein (2003) proposed that impaired co-ordination of contextually relevant information is clinically manifested in the disorganised symptoms of schizophrenia. It was thus hypothesised that scores on the Cognitive Disorganisation sub-scale of the O-LIFE would be associated with impaired performance on the ToM

tasks, and enhanced performance on the context processing tasks. The current study found no significant relationships between any sub-scales of the O-LIFE and the ToM or context processing tasks. Only non-verbal IQ significantly predicted ToM and context processing task performance. Unexpectedly, high scores on the Inrovertive Anhedonia (IA) sub-scale of the O-LIFE predicted good performance on the False Belief stories task. This seems counter intuitive as the IA subscale is the dimension with the greatest similarity to the social withdrawal, flat affect and few interests that would be associated with autism and poor ToM. Although this effect approached significance, it must be considered in light of the number of comparisons conducted and the corresponding correction in significance level required to account for Type I errors.

5.3 Thought Disorder

In the current study, thought disorder was assessed to extend and replicate the study by Uhlhaas, Silverstein, Phillips & Lovell (2004). Although they found no differences in context processing between high and low schizotypes overall, individuals who were high in both schizotypy, as measured by SPQ, and thought disorder, did demonstrate the expected pattern of results on the context processing tasks compared to high schizotypes without thought disorder and low schizotypes (who were not assessed for thought disorder). Uhlhaas et al. (2004) noted that it was likely to be the combination of high schizotypy and thought disorder that acted as a more sensitive marker for contextual processing deficits. Although they did not actually assess thought disorder in low schizotypes, they argued that it was unlikely to be thought disorder alone which could account for this effect as they predicted that low

schizotypy combined with high levels of thought disorder would be a rare combination. The present study tested this by assessing thought disorder in both high and low schizotypes.

The current study found no group differences in total O-LIFE score between those high and low in thought disorder, replicating the finding by Uhlhaas et al. (2004). This suggests that thought disorder and schizotypy are independent, but contrasts with the study by Coleman, Levy, Lenzenweger & Holzman, (1996), which found high schizotypes, as measured by the Perceptual Aberrations Scale (Chapman, Chapman & Raulin, 1978), to have higher levels of thought disorder. Like Uhlhaas et al. (2004), the current study did not find any group differences in Cognitive Disorganisation scores on the O-LIFE between those high and low in thought disorder. Given the low frequency of more severe categories of thought disorder in the current study, this suggests that thought disorder in the non-clinical population is too subtle to relate to features associated with Cognitive Disorganisation.

The current study did not find any group differences in ToM or context processing task performance when high schizotypes with thought disorder were compared to those with low thought disorder. The current study assessed low schizotypes for thought disorder, and found no significant differences in comparison to high schizotypes. This indicates that further investigation is required to determine the possible role of thought disorder in relation to schizotypy and context processing.

5.4 Summary and Future Directions

The current study failed to find any support for the hypothesis that impaired ToM in high schizotypes, and by extension schizophrenia, is a function of impaired context processing. Rather than providing support for modular accounts of ToM, this study has highlighted difficulties with the tasks used to assess what is likely to be a subtle effect in the non-clinical population. Further extended replications are required with careful consideration of the best tests of ToM and context processing. This is important because understanding the mechanisms of impaired ToM in schizophrenia could help inform clinical interventions. If impaired ToM is associated with impaired context processing, then emphasising the contextual gestalt in social situations might be helpful. This could be at multiple levels, such as techniques to help process facial expressions and strategies to help map relationships between the different components of a social scenario.

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Part 3: Critical Appraisal

1. Introduction

Maintaining a reflective log has highlighted a number of interesting issues that have arisen at various stages throughout the research process. This critique begins by describing an assumption I have held about the importance of statistically significant results, tracing its evolution with reference to the relevant literature on the 'file drawer' effect. I then describe some of the research decisions made at a methodological level, considering the affordances and constraints involved. Finally, I explore an ethical issue that has struck me relating to research within the schizotypy paradigm and consider this in relation to the maladaptive versus adaptive features of high schizotypy and the importance of language from a social constructionist perspective.

2. The Importance of Significance

From the start of the research process, I held a relatively implicit assumption that a carefully planned and well-conducted study would produce significant results and ultimately, a publishable paper in a peer-reviewed journal. As the research progressed, this assumption became more explicit, peaking in excitement during the start of the analysis phase and then ending in surprisingly bitter disappointment when the completed analysis for all nine hypotheses produced non-significant results. This left me wondering whether my non-significant results were in fact 'insignificant' results of no importance or relevance.

There are three main reasons for non-significant results. The first is that no effect was found because the study did not have sufficient statistical power: a Type II error. The second is that the study did not detect any significant effect because the methodology was flawed. The third is that the effect may not in fact exist at all. It is unlikely that the current study had insufficient power as the number of participants was calculated at the outset using a power analysis and the required sample size was achieved. Some aspects of the methodology may have been flawed. In particular, the use of Block Design as a test of context processing may not have been sensitive enough to pick up differences between high and low schizotypes, given that individuals with schizophrenia have been shown to have preserved rather than enhanced abilities (Green & Walker, 1985) on this task. The decision to use Block Design was based on the fact that individuals with autism have shown enhanced performance on this measure (Shah & Frith, 1993). Published studies have found significant results with healthy individuals varying in schizotypy on the Hidden Figures Test (Tsakanikos & Reed, 2003) and False Belief Story (Langdon & Coltheart, 1999) and with individuals with schizophrenia on the Eyes Test (Uhlhaas, Phillips, Schenkel & Silverstein, 2006). It was for this reason that extended replications of the above studies were chosen and that statistically significant results were predicted in the present sample.

Regarding the third reason for non-significant results, I wondered how many other studies investigating context processing and ToM in schizophrenia and schizotypy had also found non-significant findings, and whether there is a 'file drawer' problem, whereby results that are not statistically significant go unpublished (Dickersin, 1990). Studies with significant results have been shown to have increased odds of publication (Easterbrook, Berlin, Gopalan, & Mathews, 1991; Dickersin, Min &

Meinert, 1992). Taken to the extreme, this tendency would suggest that a proportion of studies in the literature may reflect randomness resulting from Type I errors (Sterling, 1959). Previous research has found reviewers (Mahoney, 1987) and editors (Zanna, 1992) to be responsible for the absence of non-significant results in the literature. More recent research suggested that despite the majority of researchers believing journals hold an implicit policy not to publish non-significant results, more than half of such manuscripts submitted for publication were accepted (Reysen, 2006). This suggests that journal editors may have changed their views (Fidler, Thomason, Cumming, Finch & Leeman, 2004), while authors have not (Reysen, 2006). As a means of managing the file drawer effect, Cooper (1999) proposed that all studies should be catalogued on a research register at the time they are initiated rather than when they are published. In conjunction with published studies, this would enable researchers to consider a broader range of research when generating hypotheses and considering results. There have also been calls for increased education about the value of non-significant results (Wilkinson & APA Task Force on Statistical Inference, 1999).

Having considered the above literature on the file drawer effect in psychology, I felt more assured that my non-significant results would not necessarily be dismissed as insignificant results. It also made me reflect on the ethical importance of disseminating non-significant results, given the time and money which could be spent examining previously studied topics. In this respect, access to non-significant findings is important to allow researchers to draw their own conclusions on the findings and to adapt future studies accordingly.

3. Methodological Issues & Decisions

3.1 Participants and the Importance of Language

The word 'schizophrenia', and by extension 'schizotypy', tend to be heavily stigmatised words which come with a lot of negative assumptions. It is thus not surprising that such assumptions are likely to influence responses on questionnaires which incorporate these terms. Defensive responding has been cited as a possible explanation for the lower than expected rate of positive schizotypal characteristics self-reported by the relatives of individuals with schizophrenia (e. g. Yaralian et al, 2000). There is not the same type of defensive responding with negative symptoms, perhaps reflecting the fact that positive schizotypal symptoms are a more obvious characteristic of psychosis-proneness, even though negative symptoms are actually considered a more important determinant of genetic liability to schizophrenia (MacDonald et al., 2001; Tsuang et al., 2002). Mohr & Leonards (2005) investigated this effect of defensive responding by manipulating the information that participants received about a schizotypy questionnaire. Positive schizotypy scores were significantly higher when the schizotypy measure was couched in the context of a study on creativity rather than a psychiatric study. There were no differences with regards to negative schizotypy scores between the two groups.

Defensive responding has important implications for studies investigating schizotypy, emphasising the need for sensitive consideration of the context in which a study is presented to participants, whilst also respecting their right to accurate information. Equally, it is important for schizotypy researchers to be transparent in publications

about the information participants received. This will enable the reader to consider the possible influence of defensive responding on any findings. In the present study, it was felt that the use of the term 'personality' was relatively neutral, not involving possibly negative associations with the term 'schizotypy' nor the positive associations of 'creativity'.

3.2 Choosing Appropriate Measures

3.2.1 ToM

The current study found that performance on the False Belief stories (Langdon & Coltheart, 1999) and Eyes Test (Baron-Cohen, Wheelwright, Hill, Raste & Plumb, 2001) were not significantly correlated with one another, highlighting how ToM is a multifaceted construct. The diversity of tasks used to assess ToM in relation to schizophrenia has been cited as one possible reason for the lack of consistent results in this field (Harrington, Siegert & McClure, 2005). This emphasises the need for careful consideration from the outset of a study of what aspect of ToM is being assessed. One distinction made in the literature is between cognitive and affective or "cold" and "hot" ToM (Brothers & Ring, 1992), with neuropsychological evidence suggesting dissociation between the two (Shamay-Tsoory, Tomer, Berger & Aharon-Peretz, 2005). According to this distinction, false belief tasks (Wimmer & Perner, 1983) would be considered cold ToM, as a cognitive understanding of the difference between two characters' knowledge is required. In contrast, the Eyes Test, irony and faux pas require hot ToM as an empathic appreciation of a character's emotional state is also necessary (Shamay-Tsoory et al., 2007).

Reflection on our own experiences of ToM in real life settings suggests that it is a subtle, intuitive process that requires little explicit thought. This contrasts sharply with experimental manipulations designed to test ToM, which raises important questions about their ecological validity. Is it possible that relatively cumbersome ToM tasks underestimate performance in patients with schizophrenia? McCabe, Leudar & Antaki's (2004) analysis of clinical interviews showed that individuals with schizophrenia did use ToM to communicate successfully in terms of appreciating that their interviewers had different beliefs from their own. Although these individuals were not tested on standard ToM tests, Frith (2004) predicted that many individuals with schizophrenia would show relatively intact ToM in their conversations, but still perform badly on experimental manipulations of ToM. Frith (2004) related this difference to the 'on-line' nature of ToM in natural settings compared to the 'off-line' process involved in most ToM tasks. The latter typically require an explicit, reflective stance on ToM which may be more impaired in schizophrenia. The development of more ecologically valid 'on-line' ToM tasks will help explore Frith's (2004) hypothesis.

3.2.2 Context Processing

The choice of context processing tasks in the present study was determined by previous research that had found significant results in studies with participants with schizophrenia, autism and schizotypy. Published studies which had found significant effects using the schizotypy paradigm were the priority, as there was concern about the sensitivity of tasks to detect what was expected to be a subtle effect in a non-clinical population. Tsakanikos & Reed's (2003) study reported a large effect size

using the Hidden Figures Test. However, rather than predicting high schizotypy scores on the Cognitive Disorganisation sub-scale of the O-LIFE to be associated with enhanced Hidden Figures Test performance like the current study, they predicted impaired performance, particularly associated with high scores on the Introvertive Anhedonia sub-scale, which they hypothesised reflected impaired frontal lobe function. No reference in their paper was made to the literature relating schizophrenia and high schizotypy to contextual processing deficits, which have been shown to manifest in *enhanced* performance when tasks are used in which context is typically distracting (Uhlhaas & Silverstein, 2005).

The Hidden Figures test is very similar to the Embedded Figures Task (Witkin, Oltman, Raskin & Karp, 1971), in which improved performance in autism has been related to context processing deficits (Jarrold, Butler, Cottington & Jimenez, 2000). Pickup & Frith (2001) predicted that high schizotypy would be associated with enhanced performance on a modified version of the Embedded Figures Task (Pickup, 1997), in which participants had to find a hidden object within a picture. The object was presented to participants as a cut out piece of laminated card, which participants could move over the picture if they wished. Pickup & Frith (2001) found no significant differences in accuracy or speed of performance on this task between high and low schizotypes. When choosing appropriate context processing tests for the current study, it was hypothesised that Pickup's (1997) task might not have been sensitive enough to detect context processing deficits. In the Hidden Figures Test, participants have to choose which of five hidden shapes (present throughout the task) is hidden in a complex figure but the shapes cannot be cut out and moved over the complex figures. In this respect, it is a more challenging task. However, the current

study's non-significant result confirms Pickup & Frith's (2001) study and contrasts with Tsakanikos & Reed's (2003) findings. There are no identifiable methodological reasons for the contrast in findings between the current study and Tsakanikos & Reed (2003). This highlights the need for further replication of Tsakanikos & Reed's (2003) study.

3.2.3 Assessing Thought Disorder

The Thought and Language Index (Liddle, 2002); the Thought Disorder Index (Johnston & Holzman, 1979) and the short version of the Thought Disorder Index (Carpenter et al., 1993) were considered as possible measures when choosing how to assess thought disorder in the present study. The Thought and Language Index was designed to be shorter and easier to code than the full TDI, consisting of fewer categories. Although the short version of the TDI overcame the time limitations of the full version, it still had a difficult and cumbersome coding structure. Despite the Thought and Language Index being a simpler tool to administer, it was finally decided to use the short version of the TDI to enable extended replication of the study by Uhlhaas, Silverstein, Phillips & Lovell (2004).

Using this tool, coding responses according to the manual was a difficult and very lengthy process. It was often felt that the manual was too short and did not sufficiently elaborate on the various categories or provide enough examples. For example, the manual defines the 'Stilted, Inappropriate Expression' category as "awkwardly phrased and stilted sounding expressions" and gives the following example: "What suggested it? [experimenter] Just its overall picture [participant]". I

don't think it is clear what is stilted or awkward about this example. Cases like this meant that I had to develop my own rules to determine what I thought could be considered slightly unusual about such examples so that the same rule could be applied to similar instances. In the above example, I felt it was the way in which the response was vague, and not explicitly related to particular aspects of the stimulus that meant it could be considered 'Stilted and Inappropriate'. It was also necessary for me to explicitly formalise such rules in response to vagueness in the manual in order to train my second coder. This process undoubtedly contributed towards the high level of inter-rater reliability achieved, but also highlights how this will reflect my own subjective interpretations of ambiguities in the manual, which were taught to the second coder. Although not acknowledged, other researchers must have encountered the same difficulties. This means that they too will have had to develop their own rules to manage instances of vagueness in the manual. It is possible that variety in such rules between researchers results in thought disorder being recorded differently across studies. This problem could be resolved by a more elaborated manual or standardised training programmes in using the measure.

Once half of the TDI data had been second coded, I had to find the best way of calculating the inter-rater reliability. The Kappa statistic is often used to rate the degree of agreement between raters for categorical data. Kappa's calculation uses a term called the 'proportion of chance agreement', which is interpreted as the proportion of times raters would agree by chance alone. However, there were practical and conceptual problems with applying this method to the thought disorder data. Practically speaking, each participant's data set could vary along several dimensions that would need to be considered including the total number of responses;

the total number of thought disordered responses; the category of each thought disordered response; their severity; and whether the same speech utterance was identified as thought disordered. As the total number of responses is continuous and not categorical, inter-rater agreement for this variable would have to be determined using the interclass correlation coefficient. Kappa statistics would then have to be calculated for each of the categorical variables, and then an average of all these calculations made. This would have been likely to inflate the degree of concordance as it is the simultaneous occurrence of all these variables that is important.

Conceptually, the validity of the Kappa statistic as a 'chance-corrected' measure has been questioned, as this is only relevant under conditions of statistical independence of the raters (Maclure & Willet, 1987). Raters are clearly dependent if they have been trained to rate the same phenomenon. Given these practical and conceptual difficulties, it was decided to report the interclass correlation coefficient for the agreement for the total number of ideas expressed (as this is used in calculating the total thought disorder index score), and to report the percentage agreement between raters for the co-occurrence of the categorical variables.

3.3 Controlling for Confounding Variables: The Potential Importance of Mood

The current study controlled for IQ and executive functioning in relation to task performance, but the potential role of mood was not considered at the design phase. However, it is possible that mood may interact with context processing. Positive mood and optimism have been associated with a global bias and inversely related to a local bias, while individuals with depression and trait anxiety have been related to a

tendency for a local processing style (Basso, Schefft, Ris & Dember, 1996). Similarly, trait anxiety has been associated with enhanced left hemisphere activation during negative emotional states, which in turn facilitates local perceptual information processing (Derryberry & Reed, 1998). In this respect, depression and anxiety may interact with context processing deficits to confer an even greater advantage on context processing tasks. If ToM is also a form of context processing, then mood could also impair performance on ToM tasks. Anecdotally, there were no obvious indicators of the impact of mood on performance in the present study. However, subtle influences of mood with non-clinical samples should be considered in future, and this is likely to be even more important with clinical samples where levels of co-morbid anxiety and depression would be higher.

4. Schizotypy: Maladaptive versus Adaptive Functioning

High schizotypy, particularly variables related to perceptual aberration, magical ideation and social anhedonia, have been identified as good indicators for proneness to psychosis (Chapman, Chapman, Kwapil, Eckbald & Zinser, 1994). As risk factors for psychosis have been associated with the need for targeted early intervention programmes (Olin & Mednick, 1996), I have wondered whether researchers have an ethical obligation to inform high schizotypes of the potential risk associated with their personality traits. Such advice would certainly be likely to cause alarm, and could also be misplaced without a thorough understanding of genetic and environmental precursors to psychosis likely to interact with individual traits. Olin & Mednick (1996) suggested that risk factors be combined to form a multiple risk index to help target early intervention programmes. Assessing the contribution of personality traits

to such an index might be most appropriate when there is already good evidence for existing genetic and environmental risk factors. In the absence of such complex data, and more importantly, participants' explicit consent, such information could be more damaging than helpful.

Discussing high schizotypy in relation to psychosis proneness suggests that it is an undesirable feature synonymous to a deficit or impairment. However, high schizotypy, particularly positive schizotypy, has also been associated with creativity (e. g. Schuldberg, 2000), which helps explain why relatives of individuals with psychosis have a higher incidence of creative achievement (Brod, 1997). Equally, high schizotypy has been associated with enhanced spirituality (Fisher et al., 2004). For example, schizotypy items such as "It has seemed as if my body is melting into my surroundings" are experiences reported by those who practice meditation (Kabat-Zinn, 1990).

Contextual processing "deficits" found in high schizotypy and schizophrenia can also be considered with regards to adaptive consequences. Within the field of autism, it was suggested that weak central coherence represented a 'cognitive style' rather than a deficit (Firth, 1989; Happé, 1999), as it provided advantages in situations where a local information processing bias was required. In real life settings this has been related to advantages in fields such as engineering, mathematics and physics (Baron Cohen et al., 1997), suggesting that high schizotypy might also have similar benefits. This has important implications for clinical interventions based on context processing 'deficits' in psychosis. Although it may be beneficial to consider the possible role of contextual processing 'deficits' in interventions aimed at improving ToM, it also

suggests that equal consideration should be given to identifying relative strengths that an individual's cognitive style affords.

Acknowledgement of adaptive affordances in addition to maladaptive constraints is important, and has made me think about the need for a sensitive use of language in research and clinical contexts, particularly given the power of words when considered from a social constructionist perspective (Walker, 2006). Although superficially subtle, I don't think differences between linguistic nuances such as "deficit" and "cognitive style" should be dismissed as 'political correctness gone mad', but rather encouraged as opportunities to acknowledge the diversity of experiences that exist on a continuum. Although I have used the word 'deficit' in relation to context processing throughout this thesis, I have decided to leave it as such to help show the evolution of ideas encouraged by the process of reflection and reflexivity. However, I hope that any potential publication and my future practice will be informed by such ideas.

5. Conclusions

Two principal themes have emerged from this critical appraisal. The first concerns attitudes towards statistically non-significant results. There is undoubtedly a general sense in which non-significant results are met with disappointment and as a sign of failure. However, the literature on the 'file drawer' effect highlights the importance of non-significant results from methodologically sound studies. The present study failed to replicate two published studies. This emphasises the need for further extended replications, and for careful consideration of methodological choices such as how to measure ToM, context processing and thought disorder.

The second theme concerns language. The autism literature typically demonstrates a use of language which could be described as 'person centred'. There is a sensitive awareness of the power of words. The schizophrenia/schizotypy literature seems to lack a similar degree of awareness, using a language which often appears 'disorder centred'. Addressing the use of language, and more importantly, the thoughts, beliefs and ideas that language conveys, could help address issues such as stigma by acknowledging individual differences in less stigmatising ways.

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Appendix 1

Schizotypal Personality Scale (STA; Claridge & Broks, 1984)

STA SCREENING QUESTIONNAIRE –CONFIDENTIAL

Please answer each question by circling Y or N.

1. Do you believe in telepathy?
   Y N

2. Do you often feel that other people have it in for you?
   Y N

3. When in the dark do you often see shapes and forms, even though there's nothing there?
   Y N

4. If you say you will do something, do you always keep your promise no matter how inconvenient it might be?
   Y N

5. Does your own voice ever seem distant, faraway?
   Y N

6. Does it often happen that almost every thought immediately and automatically suggests an enormous number of ideas?
   Y N

7. Do you ever become over sensitive to light or noise?
   Y N

8. Were you ever greedy by helping yourself to more than your share of anything?
   Y N

9. Do you often have vivid dreams that disturb your sleep?
   Y N

10. When you are worried or anxious do you have trouble with your bowels?
    Y N

11. Have you ever felt when you looked in a mirror that your face seemed different?
    Y N

12. Have you ever blamed someone for doing something you knew was really your fault?
    Y N

13. Do you think it is safer to trust nobody?
    Y N

14. Do things sometimes feel as if they were not real?
Y N

15. Do you feel lonely most of the time even when you're with people?
Y N

16. Are *all* your habits good and desirable ones?
Y N

17. Do everyday things sometimes seem unusually large or small?
Y N

18. Are you often bothered by the feeling that people are watching you?
Y N

19. Do you feel that you cannot get 'close' to other people?
Y N

20. Have you ever taken anything (even a pin or a button) that belonged to someone else?
Y N

21. Do you dread going into a room by yourself where other people have already gathered and are talking?
Y N

22. Does your sense of smell sometimes become unusually strong?
Y N

23. Are you sometimes sure that other people can tell what you are thinking?
Y N

24. Have you ever broken or lost something belonging to someone else?
Y N

25. Have you ever had the sensation of your body or part of it changing shape?
Y N

26. Do you ever feel sure that something is about to happen even though there doesn't seem to be any reason for your thinking that?
Y N

27. Do you ever suddenly feel distracted by distant sounds that you are not normally aware of?
Y N

28. Have you ever said anything bad or nasty about anyone?
Y N

29. Do you ever have a sense of vague danger or sudden dread for reasons that you do not understand?
Y N

30. Have you ever thought you heard people talking only to discover that it was in fact some nondescript noise?
Y N

31. Do your thoughts ever stop suddenly causing you to interrupt what you're saying?
Y N

32. As a child were you ever cheeky to your parents?
Y N

33. Do you feel that you have to be on guard even with your friends?
Y N

34. Do you feel that your thoughts don't belong to you?
Y N

35. When in a crowded room do you often have difficulty in following a conversation?
Y N

36. Have you ever cheated at a game?
Y N

37. Do you sometimes feel that your accidents are caused by mysterious forces?
Y N

38. Do you feel at times that people are talking about you?
Y N

39. Do you believe that dreams can come true?
Y N

40. Have you ever taken advantage of someone?
Y N

41. Do you ever feel that your speech is difficult to understand because the words are all mixed up and don't make sense?
Y N

42. Are your thoughts sometimes so strong that you can almost hear them?
Y N

43. When coming into a new situation, have you ever felt strongly that it was a repeat of something that has happened before?
Y N

44. Do you always practice what you preach?
Y N

45. Have you ever felt that you were communicating with another person telepathically?
Y N

46. Are you easily distracted from work by daydreams?
Y N

47. Are you very hurt by criticism?
Y N

48. Do you sometimes put off until tomorrow what you ought to do today?
Y N

49. Do you ever get nervous when someone is walking behind you?
Y N

Appendix 2

The Oxford-Liverpool Inventory of Feelings and Experiences (O-LIFE; Mason et al., 1995).

Please read these instructions before completing the questionnaire:

These questions relate to your thoughts, feelings, experiences and preferences. There are no right or wrong answers or trick questions so please be as honest as possible.

For each question please choose either YES or NO and circle this on the form.

1. Do you often hesitate when you are going to say something in a group of people whom you more or less know?	Yes	No
2. Do you often overindulge in alcohol or food?	**Yes**	**No**
3. Are the sounds you hear in your daydreams really clear and distinct?	**Yes**	**No**
4. Do you enjoy many different kinds of play and recreation?	**Yes**	**No**
5. Do your thoughts sometimes seem as real as actual events in your life?	**Yes**	**No**
6. Does it often happen that nearly every thought immediately and automatically suggests an enormous number of ideas?	**Yes**	**No**
7. When in a group of people do you usually prefer to let someone else be the centre of attention?	**Yes**	**No**
8. Do you frequently have difficulty in starting to do things?	**Yes**	**No**
9. Has dancing or the idea of it always seemed dull to you?	**Yes**	**No**
10. When you catch a train do you often arrive at the last minute?	**Yes**	**No**
11. Is trying new foods something you have always enjoyed?	**Yes**	**No**
12. Do you often change between intense liking and disliking of the same person?	**Yes**	**No**
13. Have you ever cheated at a game?	**Yes**	**No**
14. Are there very few things that you have ever really enjoyed doing?	**Yes**	**No**
15. Do you at times have an urge to do something harmful or shocking?	**Yes**	**No**
16. Do you often worry about things you should not have done or said?	**Yes**	**No**
17. Are your thoughts sometimes so strong that you can almost hear them?	**Yes**	**No**
18. Are you usually in an average sort of mood, not too high and not too low?	**Yes**	**No**
19. Would you take drugs which may have strange or dangerous effects?	**Yes**	**No**
20. Do you think you could learn to read other's minds if you wanted to?	**Yes**	**No**

21. When in a crowded room, do you often have difficulty in following a conversation?	**Yes**	**No**
22. No matter how hard you try to concentrate do unrelated thoughts creep into your mind?	**Yes**	**No**
23. Are you easily hurt when people find fault with you or the work you do?	**Yes**	**No**
24. Do you stop to think things over before doing anything?	**Yes**	**No**
25. Have you ever felt that you have special, almost magical powers?	**Yes**	**No**
26. Are you much too independent to really get involved with other people?	**Yes**	**No**
27. Do ideas and insights sometimes come to you so fast that you cannot express them all?	**Yes**	**No**
28. Do you easily lose your courage when criticised or failing in something?	**Yes**	**No**
29. Can some people make you aware of them just by thinking about you?	**Yes**	**No**
30. Does a passing thought ever seem so real it frightens you?	**Yes**	**No**
31. Have you ever blamed someone for doing something you know was really your fault?	**Yes**	**No**
32. Are you a person whose mood goes up and down easily?	**Yes**	**No**
33. Does your voice ever seem distant or faraway?	**Yes**	**No**
34. Do you think having close friends is not as important as some people say?	**Yes**	**No**
35. Are you rather lively?	**Yes**	**No**
36. Are you sometimes so nervous that you are `blocked'?	**Yes**	**No**
37. Do you find it difficult to keep interested in the same thing for a long time?	**Yes**	**No**
38. Do you dread going into a room by yourself where other people have already gathered and are talking?	**Yes**	**No**
39. Does it often feel good to massage your muscles when they are tired or sore?	**Yes**	**No**
40. Do you sometimes feel that your accidents are caused by mysterious forces?	**Yes**	**No**
41. Do you like mixing with people?	**Yes**	**No**
42. On seeing a soft thick carpet have you sometimes had the impulse to take off your shoes and walk barefoot on it?	**Yes**	**No**
43. Do you often have difficulties in controlling your thoughts?	**Yes**	**No**
44. Do the people in your daydreams seem so true to life that you	**Yes**	**No**

sometimes think they are real?		
45. Are people usually better off if they stay aloof from emotional involvements with people?	**Yes**	**No**
46. Can just being with friends make you feel really good?	**Yes**	**No**
47. Is your hearing sometimes so sensitive that ordinary sounds become uncomfortable?	**Yes**	**No**
48. Have you often felt uncomfortable when your friends touch you?	**Yes**	**No**
49. When things are bothering you do you like to talk to other people about it?	**Yes**	**No**
50. Do you have many friends?	**Yes**	**No**
51. Would being in debt worry you?	**Yes**	**No**
52. Do you think people spend too much time safeguarding their future with savings and insurance?	**Yes**	**No**
53. Do you ever have the urge to break or smash things?	**Yes**	**No**
54. Do you often feel that there is no purpose to life?	**Yes**	**No**
55. Do you worry about awful things that might happen?	**Yes**	**No**
56. Have you ever felt the urge to injure yourself?	**Yes**	**No**
57. Would it make you nervous to play the clown in front of other people?	**Yes**	**No**
58. Have you felt that you might cause something to happen just by thinking too much about it?	**Yes**	**No**
59. Have you had very little fun from physical activities like walking, swimming, or sports?	**Yes**	**No**
60. Do you feel so good at controlling others that it sometimes scares you?	**Yes**	**No**
61. Are you easily distracted from work by daydreams?	**Yes**	**No**
62. Are you easily confused if too much happens at the same time?	**Yes**	**No**
63. Do you ever have a sense of vague danger or sudden dread for reasons that you do not understand?	**Yes**	**No**
64. Is it true that your relationships with other people never get very intense?	**Yes**	**No**
65. Have you sometimes had the feeling of gaining or losing energy when certain people look at you or touch you?	**Yes**	**No**
66. Do you worry too long after an embarrassing experience?	**Yes**	**No**
67. Do you love having your back massaged?	**Yes**	**No**
68. Do you consider yourself to be pretty much an average kind of person?	**Yes**	**No**

69. Have you ever taken advantage of someone?	**Yes**	**No**
70. Would you like other people to be afraid of you?	**Yes**	**No**
71. Have you ever thought you heard people talking only to discover that it was in fact some nondescript noise?	**Yes**	**No**
72. Have you occasionally felt as though your body did not exist?	**Yes**	**No**
73. Do you often feel lonely?	**Yes**	**No**
74. Do you often have an urge to hit someone?	**Yes**	**No**
75. Do you often experience an overwhelming sense of emptiness?	**Yes**	**No**
76. On occasions, have you seen a person's face in front of you when no one was in fact there?	**Yes**	**No**
77. Is it fun to sing with other people?	**Yes**	**No**
78. Do you often have days when indoor lights seem so bright that they bother your eyes?	**Yes**	**No**
79. Have you wondered whether the spirits of the dead can influence the living?	**Yes**	**No**
80. Do people who try to get to know you better usually give up after a while?	**Yes**	**No**
81. Do you often feel `fed up'?	**Yes**	**No**
82. Have you felt as though your head or limbs were somehow not your own?	**Yes**	**No**
83. When you look in the mirror does your face sometimes seem quite different from usual?	**Yes**	**No**
84. Do people who drive carefully annoy you?	**Yes**	**No**
85. Would you call yourself a nervous person?	**Yes**	**No**
86. Can you usually let yourself go and enjoy yourself at a lively party?	**Yes**	**No**
87. Do you ever suddenly feel distracted by distant sounds that you are not normally aware of?	**Yes**	**No**
88. Do you sometimes talk about things you know nothing about?	**Yes**	**No**
89. When in the dark do you often see shapes and forms even though there's nothing there?	**Yes**	**No**
90. Have you sometimes sensed an evil presence around you, even though you could not see it?	**Yes**	**No**
91. Is it hard for you to make decisions?	**Yes**	**No**
92. Do you find the bright lights of a city exciting to look at?	**Yes**	**No**
93. Does your sense of smell sometimes become unusually strong?	**Yes**	**No**
94. Do you usually have very little desire to buy new kinds of food?	**Yes**	**No**

95. Do you ever feel that your speech is difficult to understand because the words are all mixed up and don't make sense?	**Yes**	**No**
96. Do you often feel like doing the opposite of what other people suggest, even though you know they are right?	**Yes**	**No**
97. Do you like going out a lot?	**Yes**	**No**
98. Do you feel very close to your friends?	**Yes**	**No**
99. Do you ever feel sure that something is about to happen, even though there does not seem to be any reason for you thinking that?	**Yes**	**No**
100. Do you often feel the impulse to spend money which you know you can't afford?	**Yes**	**No**
101. Are you easily distracted when you read or talk to someone?	**Yes**	**No**
102. Do you feel that making new friends isn't worth the energy it takes?	**Yes**	**No**
103. Do you believe in telepathy?	**Yes**	**No**
104. Do you prefer watching television to going out with other people?	**Yes**	**No**

Thank you very much for taking the time and effort to fill this in.

Appendix 3

The Eyes Test (Baron-Cohen et al., 2001)

practice

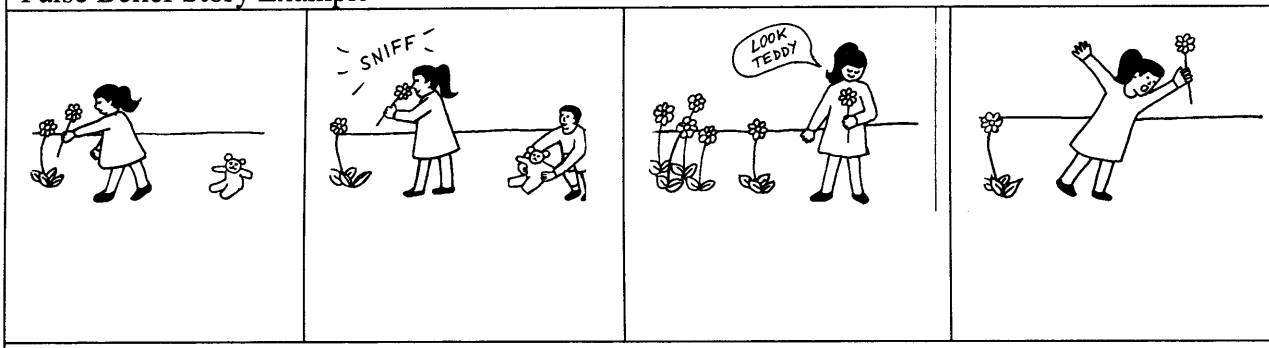
jealous panicked

arrogant hateful

Appendix 4

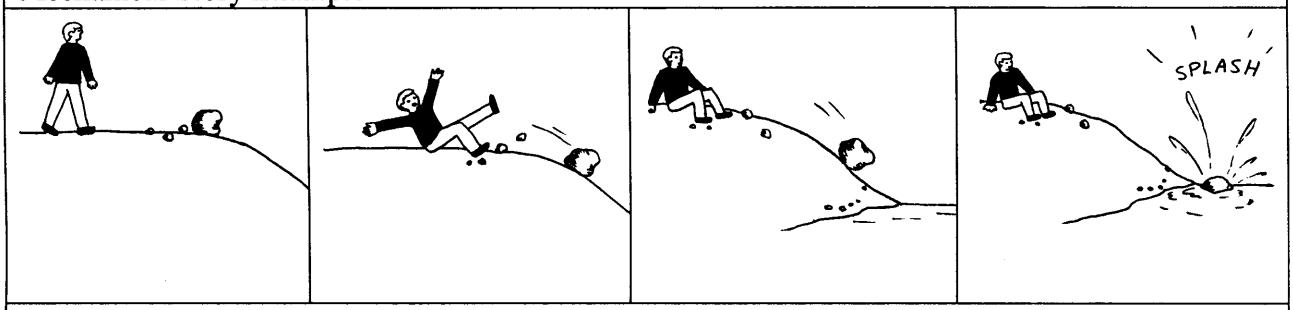
Picture-Story Sequencing Task (Langdon & Coltheart, 1999)

False Belief Story Example

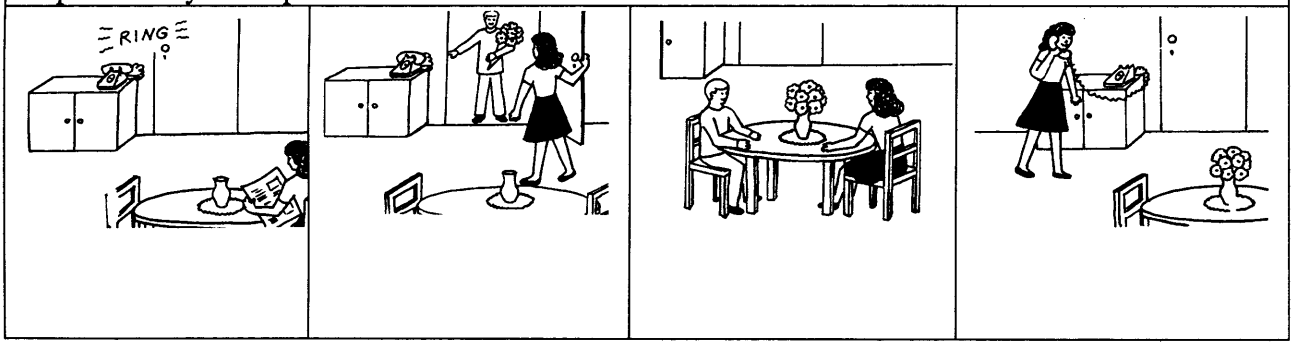


Social Script Story Example

Mechanical Story Example



Capture Story Example



Appendix 5

Hidden Figures Test (Ekstom et al., 1976)

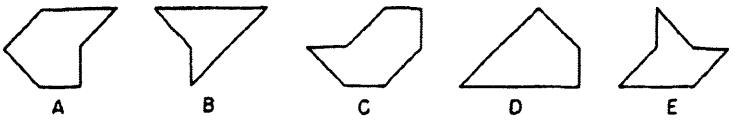
Name _____

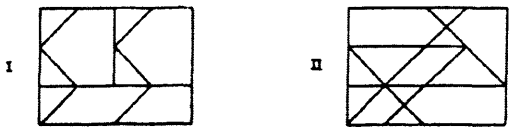
HIDDEN FIGURES TEST — CF-1 (Rev.)

This is a test of your ability to tell which one of five simple figures can be found in a more complex pattern. At the top of each page in this test are five simple figures lettered A, B, C, D, and E. Beneath each row of figures is a page of patterns. Each pattern has a row of letters beneath it. Indicate your answer by putting an X through the letter of the figure which you find in the pattern.

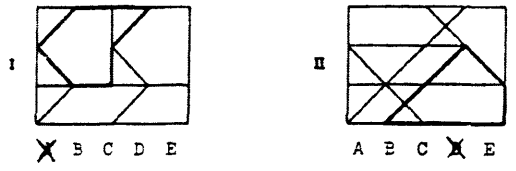
NOTE: There is only one of these figures in each pattern, and this figure will always be right side up and exactly the same size as one of the five lettered figures.

Now try these 2 examples.





The figures below show how the figures are included in the problems. Figure A is in the first problem and figure D in the second.



Your score on this test will be the number marked correctly minus a fraction of the number marked incorrectly. Therefore, it will not be to your advantage to guess unless you are able to eliminate one or more of the answer choices as wrong.

You will have 12 minutes for each of the two parts of this test. Each part has 2 pages. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

DO NOT TURN THIS PAGE UNTIL ASKED TO DO SO.

Appendix 6

Participant Information Sheet and Consent Form

Participant Information Sheet

Study Title: Relations between personality, theory of mind and cognitive style

Investigators: **Dr Graham Pickup, Department of Clinical Health Psychology, UCL, Gower Street, London, WC1E 6BT**
Tel:

Omar Cummins, Department of Clinical Health Psychology, UCL, Gower Street, London, WC1E 6BT
Tel:

You are invited to participate in a research project investigating the relationship between personality, the ability to work out what others are thinking and the way in which information from the environment is put together.

We are looking for volunteers who have English as their first language and who have no history of psychiatric illness or head injury. As a healthy volunteer, the data you provide will give us information about the processes involved in understanding social situations in the general population. This in turn will help us understand what happens when things are not working properly in clinical populations.

You will be asked to complete a brief screening questionnaire asking about some of your experiences and thoughts. After you have completed it, you will be told whether or not you are eligible to take part in the study.

If you take part, you will be asked to complete a personality questionnaire; answer questions on some cartoon stories; describe the similarities between pairs of words and the meanings of words; complete a pattern sequencing task; find some hidden objects within pictures; complete a spatial sequencing task; complete a jigsaw puzzle task and say what comes to mind in response to four picture cards. This latter task will be recorded onto audio tape and later transcribed by the experimenter. The maximum time taken for these tasks is 120 minutes.

You will be paid £12.00 for taking part.

There are no potential risks involved in this research.

All data will be collected and stored in compliance with the Data Protection Act 1988. Participants will be given an identifying code so that analyses can be conducted and written up anonymously. Paper, electronic and audio data records will be stored securely. Data will be kept until it has been accepted for publication after which it will be destroyed.

You do not have to take part in this study if you do not want to. If you decide to take part, you may withdraw at anytime without having to give a reason.

This study has been approved by the University College London Committee on the Ethics of Non-NHS Human Research.

Please feel free to ask the above researchers any questions.

Many thanks for considering taking part in this study. It is much appreciated!

Informed Consent Form

Relationships between personality, theory of mind and cognitive style

Please read each item below and tick the relevant box.

Sign and date the form.

	YES	NO
Have you read the Participant Information Sheet?		
Has the project been explained to you orally?		
Have you had the opportunity to ask questions and discuss the study?		
Have you received satisfactory answers to all your questions?		
Have you received enough information about the study? Who have you spoken to?.....		
Do you understand that you are free to withdraw from the study without penalty at any stage?		
Do you agree with the publication of the results of this study in a peer reviewed journal?		
Do you agree to have an audio record made of your responses to part of the study?		

Comment or Concerns During the Study

If you have any comments or concerns you should discuss these with the Principal Researcher. If you wish to go further and complain about any aspect of the way you have been approached or treated during the course of the study, you should email the Chair of the UCL Research Ethics Committee (gradschoolhead@ucl.ac.uk) or send a letter to: The Graduate School, North Cloisters, Wilkins Building, UCL, Gower Street, London WC1E 6BT who will take the complaint forward as necessary.

Signed:.....Date:.....

Full Name in Capitals:.....

Date of Birth.....

Signature of Witness:.....Date:.....

Full Name In Capitals:.....

Appendix 7

Ethical Approval Confirmation Letter

UCL GRADUATE SCHOOL

Dr Graham Pickup
Sub-Department of Clinical Health Psychology
UCL
Gower Street

15 March 2006

Dear Dr Pickup

Re: Notification of Ethical Approval

Re: Ethics Application: **Relationships between theory of mind, personality and cognitive style**

I am pleased to confirm that following the review of your application by the Chair of the UCL Research Ethics Committee the above research has been given ethical approval for the duration of the project.

Approval is subject to the following conditions:

1. You must seek Chair's approval for proposed amendments to the research for which this approval has been given. Ethical approval is specific to this project and must not be treated as applicable to research of a similar nature. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing the 'Amendment Approval Request Form'.

The form identified above can be accessed by logging on to the ethics website homepage: http://www.grad.ucl.ac.uk/ethics/ and clicking on the button marked 'Key Responsibilities of the Researcher Following Approval'.

2. It is your responsibility to report to the Committee any unanticipated problems or adverse events involving risks to participants or others. Both non-serious and serious adverse events must be reported.

Reporting Non-Serious Adverse Events
For non-serious adverse events you will need to inform Ms Helen Dougal, Ethics Committee Administrator (h.dougal@ucl.ac.uk), within ten days of an adverse incident occurring and provide a full written report that should include any amendments to the participant information sheet and study protocol. The Chair or Vice-Chair of the Ethics Committee will confirm that the incident is non-serious and report to the Committee at the next meeting. The final view of the Committee will be communicated to you.

Reporting Serious Adverse Events
The Ethics Committee should be notified of all serious adverse events via the Ethics Committee Administrator immediately the incident occurs. Where the adverse incident is unexpected and serious, the Chair or Vice-Chair will decide whether the study should be terminated pending the opinion of an independent expert. The adverse event will be considered at the next Committee meeting and a decision will be made on the need to change the information leaflet and/or study protocol.

UCL Graduate School, North Cloisters, Wilkins Building
University College London Gower Street London WC1E 6BT
Tel: +44 (0)20 7679 7844 Fax. +44 (0)20 7679 7043
h.dougal@ucl.ac.uk
www.ucl.ac.uk/gradschool

On completion of the research you must submit a brief report (a maximum of two sides of A4) of your findings/concluding comments to the Committee, which includes in particular issues relating to the ethical implications of the research.

Yours sincerely

Sir John Birch
Chair of the UCL Research Ethics Committee

Cc: Omar Cummins, Sub-Department of Clinical Health Psychology, UCL